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ABSTRACT

The project described was designed to develop a strategy using computers and cross-aged instruction to: (1) increase basic skill levels of mathematically low-achieving sixth graders; (2) increase enrollments in high school science and mathematics; (3) evaluate microcomputers as unique instructional tools; and (4) develop effective applications of microcomputers in education. Fall semester 1980 was scheduled for planning, spring 1980-81 for the pilot phase, and the 1981-82 school year the experimental phase. The two target populations were: (1) able tenth and eleventh graders, and (2) mathematically low-achieving sixth graders. The many problems that have occurred during program implementation were noted. The view expressed is that, given the purposes of the pilot study, the difficulties, and the fact that some of the data from the pilot phase is incomplete, the results obtained to date are encouraging. The potential for long-term impact on the motivation and achievement of students by activities directly related to the project are seen to be great. The goals of the pilot phase are considered achieved, and significant positive change with respect to achievement, attitude, and enrollment are anticipated in the experimental phase. (MP)

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PERSONAL COMPUTERS AND CROSS AGED INSTRUCTION

FIRST YEAR REPORT **

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2. The parents who gave permission for their children to participate in the project.

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Mr. Bud Harris, Skyline High School, Longmont, Colorado

Mr. Frank Lamirand, Columbine Elementary School, Longmont, Colorado

Mr. Duane Squires, Spangler Elementary School, Longmont, Colorado

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Dr. Jerry Trowbridge, Acting Assistant Superintendant for Instruction

Ms. Dorothy Hores, Director of Planning, Evaluation and Communications

Mr. Randy Wallace, Coordinator of Mathematics

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Mr. Paul Canny, Project Director

Mr. James Podolak, Research Assistant 1980-81

Mr. William Blubaugh, Research assistant 1981-81

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Marc Swadener
Principal Investigator

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PERONAL COMPUTERS AND CROSS AGED INSTRUCTION - FIRST YEAR REPORT

INTRODUCTION

The first year of the project titled "Personal Computers and Cross Aged Instruction" was recently completed. This report is about that first year and the plans for the second and final year. An attempt has been made to make this report as detailed as possible. No doubt there will be questions about the project which have not been covered in this report. If such is the case the project staff would appreciate knowing these questions so that they can be addressed in the next comprehensive report which will be the final report. The project staff anticipate a good 1981-82 year and feel that the 1980-81 year, the pilot phase, was successful. The purpose of the pilot phase was to identify areas in which problems might occur. This was done and our experience in the 1980-81 year will help us make the coming year a success.

PROGRAM DESCRIPTION

The project is designed to develop a combinational strategy using personal computers and cross-aged instruction in order to:

1. Increase the level of basic mathematical skill of mathematically low-achieving sixth grade students.

2. Increase the number of students enrolling in high school mathematics and science courses.

3. Evaluate microcomputers as a unique instructional tool.

4. Develop effective applications of microcomputers in education.

The plan for the attainment of these goals includes the selection of sixty able high school students and sixty mathematically low achieving sixth graders, half of each group will serve as a control group. During the pre-tutoring period the high school students will study specific areas of mathematics weakness of the thirty sixth grade students, will become familiar with the operation of microcomputers, existing software and generate their own software for the purpose of tutoring the sixth graders. During the tutoring period the high school students will tutor on a one-to-one basis the sixth grade students using the microcomputer as a tool and continue their study of mathematics and microcomputers.

The anticipated results of the project include an increase in mathematical skills in both the high school and sixth grade students and increased enrollment in mathematics and science courses for the high school students.

The project is in effect for the 1980-81 and 1981-82 school years. The fall semester 1980 was for planning, spring semester 1980-81 was the pilot phase and the 1981-82 school year is the experimental phase.

SELECTION OF THE SCHOOL DISTRICT

The process of selecting a school district in which to conduct the project had several stages. In the preliminary grant request one school district had expressed interest in cooperating and had given preliminary approval for conducting the project in that school district. Subsequent to this and prior to submission of the formal proposal to the NSF there was a change in direction within that district and they decided to not pursue implementation in the district. The principal investigator then contacted several school districts and chose the St. Vrain School District, Longmont, Colorado, for continuing association with the project. There were several reasons for chosing the St. Vrain Schools:

1. Of the several school systems contacted the St. Vrain system had just completed an internal study concerning the direction that was to be taken with respect to instructional computing. The report was supportive for innovative use of microcomputers in instruction. Two other school systems that were contacted were in the process of completing similar studies and it was felt that to enter a confounding factor in these internal studies would not give the chance for those school systems to make decisions with minimal influence from outside sources. Each of these two school systems has since completed these studies.

2. A second reason that the St. Vrain system was chosen was that it is not so large that internal procedures of the district could unduly delay the conduct of the study.

3. The mix of ethnic groups in the St. Vrain system is relatively representative of the mix in the Rocky Mountain west.

4. The principal investigator had a long history of active contact with the St. Vrain Schools, as he has had with many districts in the state.

5. The administration of the St. Vrain system had expressed overwhelming commitment to carrying out the project from the time of first contact.

The last of these points is very important in instituting a project in the public school. Without this, any project would have serious difficulty. Even with this committment many problems arise that cannot be foreseen.

EQUIPMENT USED

The equipment used in the project are nine APPLE II+, 48K single disk drive (DOS 3.3) microcomputers with language systems, nine color monitors, three Epson MX-80 printers with GRAFTRAX-80 graphics capability, and three APPLE graphics tablets.

TARGET POPULATIONS

Two target populations are of interest. The first is able tenth and eleventh grade students. The second target population is mathematically low achieving sixth graders. The project staff are not concerned with the reasons why these sixth graders are experiencing difficulties learning mathematics, just that they are having the difficulty.

SAMPLES

The samples of students for this study are selected from schools in the St. Vrain Public Schools, Longmont, Colorado. The sample from the population of high school students consists of thirty-four students (twenty-nine for the pilot phase) from Skyline High School. A control group of equal size has also been selected from this same school. The sample of sixth graders will consist of thiry-four (twenty-nine for the pilot phase) students selected from the students in Columbine and Spangler Elementary Schools.

SELECTION CRITERIA

Secondary students were to be selected based on the following criteria.

1. Expressed interest.
2. Parental approval.
3. Concurrent enrollment in either Geometry or Algebra II.
4. Enrollment in grade ten or eleven.
5. Stanford Achievement Test - Mathematics subtest score at or above the fifth stanine.

An appropriate size sample (n=29) for the pilot phase was achieved without culling from a larger than needed supply of students satisfying the above criteria. This had both an advantage and a disadvantage. The advantage was that there was no need to reject students for the experimental group. This prevented having students disappointed at not being selected. The disadvantage was that there was no readily available control group of students who were not selected from the pool of candidates who satisfied the above criteria.

This delayed the identification of control group.

Identification of the experimental and control groups for the experimental phase of the project was not as easily accomplished. Due to unknown causes the announcement of the availability of the project classes was not included in the schedule of courses for the fall semester 1981 at Skyline High School. Because of this, when the time came for the project classes to begin there were only four students enrolled in the project classes (this was to be the experimetal group). The staff therefore had to search for students who had some freedom in their schedules to add the project class. An additional thirty students were recruited, however the exact background with respect to the above selection criteria of the resulting experimental group is still being determined. A high school control group for the experimental phase is also being identified.

For the pilot phase the criteria for selection for the experimental group of sixth grade students was the following:

1. Enrollment in the sixth grade.
2. A score of less than the sixtieth prcentile on the district-wide criterion referenced (CRT) mathematics test.
3. Parental approval.
4. Teacher recommendation.

Criteria number four was included since it was conceivable that some personal factors might prevent a student from benefiting from a one-on-one tutoring situation. Teachers seemed to be the best source for this information. Given these criteria, there was no difficulty in identifying sufficient numbers of students for the sixth grade experimental group during the pilot phase. Identification of the experimental group for the experimental phase has just begun. Criteria and procedures similar to that of the pilot phase are being used during the experimental phase. Working with two elementary schools and desiring about thirty students satisfying these criteria caused the project staff to resort to a control group that was a random selection of the remaining sixth graders. This in turn caused the use of statistical analyses which would equate the experimental and control groups on selected covariates.

THE COMMUNITY

Longmont, Colorado is a growing community with a population of about 40,000. Originally an agricultural center, the city is now rapidly growing and changing into a suburburban community on the fringe of the Denver metropolitan area. The community is attracting several light industrial companies which are planning to build large facilities in Longmont. Thus the total community is in transition from agricultural to a more suburban-light industrial orientaion.

The ethnic mix of the school district is somewhat typical of communities of its size in the Rocky Mountain region. The school district student population was (1980-81) 88.25% white, 9.88% Hispanic and 1.87% other minority (Native American, Black, and Asian).

Spangler Elementary School had a student enrollment of 450 (1980-81) which was 9.8% Hispanic, 86.7% white and 3.6% other minorities. The mobility rate for the school was 62% as compared to the district average of 28%. 21.8% of the students in the school applied for the free lunch program and 7.1% applied for the reduced lunch program.

Columbine Elementary School had a student enrollment of 363 (1980-81) and was approximately 32% Hispanic, 65.3% white and 2.7% other minorities. The mobility rate for Columbine Elementary School was 32%. 41% of the students in the school applied for the free lunch program and 5% applied for the reduced lunch program.

Skyline High School's student enrollment was 860 (1980-81). The student body was 10.2% Hispanic, 87.2% white and 2.6% other minorities. 9.2% of the students had applied for a free lunch and 2.1% had applied for reduced lunch. Skyline has a mobility rate of 32%.

** PILOT PRE-TUTORIAL PERIOD

Since two elementary schools were to be utilized, two sections of the project class were scheduled. One class was to be transported to one of the two elementary schools during the tutoring period and the other to the second elementary school. The approximate distribution of the experimental group high school students between the two sections was twenty in one section, ten in the second. (see FIGURE 1 on the next page.)

During the pilot phase the experimental group high school students met with the project director fifty minutes each day, five days a week, for nine weeks prior to tutoring in the elementary schools. These classes met in the afternoon with one period between the two sections. The content of these forty-five hours of instruction was the following:

A. Testing and Administration (10% - 4.5 hours)

B. Tutoring preparation (50% - 22.5 hours)

1. Techniques of tutoring
2. Characteristics of sixth graders
3. Psychology of learning
4. Stages of development
5. Lesson planning
6. Discipline
7. Active vs. passive learning
8. Problem solving
9. Sixth grade mathematics curriculum scope and sequence
10. Reinforcement
11. Memory and mastery
12. Estimation

FIGURE 1. Time line for structure of the pilot and experimental phases.

Pilot phase: Spring 1981

February	March	April	May
Pre-tutorial period		Tutorial period	

- Nine weeks
- Two sections (afternoon)

- Eight weeks
- Two sections (afternoon)

Experimental phase: Fall and Spring 1981-82

Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May
Pre-tutorial period					Tutorial period			

- Eighteen weeks (Fall)
- two sections (mornings)

- Seventeen weeks (Spring)
- Two sections (mornings)
- Four machines transported(?)

Characteristics common to both the pilot and experimental phases.

Pre-tutorial period

- High school only
- Five classes per section per week

Tutorial period

- High school and two Elementary schools
- High school students are transported
- Tutoring takes place in the elementary schools
- For each two week time period:
  - Five classes/section in elementary schools and high school
  - Classes in elementary and high school on alternate days

13. Questioning

C. Microcomputers (40% - 18 hours)

1. Orientation to hardware
2. Hardware capabilities
3. Operating procedures
4. Vocabulary
5. Elementary programming commands
6. Software review (drill and practice, tutorials, simulations and games)
7. Variables and variable names
8. Social impact of computers

** EXPERIMENTAL PRE-TUTORING PERIOD

The arrangement of time for the project classes at the high school during the experimental phase of the project (the 1981-82 school year) is anticipated to be in approximately the same proportions as it was in the pilot phase (see above). It is anticipated that some additional content will be included, some changed and possibly some deleted for the 1981-82 year. The actual time in the classes during the experimental phase will be doubled from that in the pilot phase since the treatment time will be twice as long. Also during the 1981-82 school year the time of day for the project classes has been changed to mornings.

** PILOT - TUTORIAL PERIOD

The tutoring sessions took place in the two elementary schools. The high school students were transported to the elementary schools by a district school bus. The distance from the high school to each of the elementary schools is approximately one mile. The high school students tutored, on a one-to-one basis, the sixth grade students identified as experimental group students. This tutoring took place, as much as possible, during the time of mathematics instruction in the sixth grades.

A. Amount of tutoring time

The amount of time available for tutoring was dependent on the length of the classes at the high school. Each high school period was fifty minutes in length, the high school students being transported to the elementary schools by district school bus. Round trip transportation time was between fifteen and twenty minutes, permitting approximately thirty minutes for each tutoring session. One section of the high school students was transported to one elementary school and the other to the second elementary school. The ratio of the number of high school students in the two sections was approximately equal to the ratio of the enrollments in the two elementary schools (2:1). High school students were transported to the elementary schools every other day (Tuesday and Thursday one week, Monday-Wednesday-Friday the next week). On other days the high school students remained at the high school, planned for the tutoring sessions and continued their familiarization with microcomputers. Thus the total amount of time actually tutoring elementary school students over the eight weeks was about 10 hours.

B. Computer time in the tutoring situation

The distribution of equipment over the three schools was such that the high school retained four machines for continued training of the high school students, three machines were placed in one elementary school and two were placed in the other. No machines were transported between schools for tutoring. Thus, over the eight weeks of the tutoring period, the total computer time available to the elementary students was sixty-seven hours. This time had to be distributed over the twenty-nine elementary students, therefore each elementary student was able to use a computer (under the direction of a high school student) for at most 2.3 hours over the eight weeks or an average of slightly more than one-half hour for each two weeks.

C. Non-computer tutoring time

The secondary students, under the direction of the elementary student's regular teacher and Mr. Canny, the Project Director, assessed the elementary students mathematical difficulties and provided tutoring on a one-to-one basis. Over the eight week tutoring period the secondary students provided each sixth grader about 8.7 hours of "off line" tutoring concerning the sixth grader's mathematical difficulties.

D. Timing of the tutoring sessions

As much as possible, tutoring took place during the period of regular mathematics instruction in the elementary schools. Because of this the elementary participants in the project received one-to-one tutoring in place of up to one half of their regular mathematics instruction for the eight weeks in the tutoring phase.

EXPERIMENTAL - TUTORIAL PERIOD

The experimental tutorial period will be a full semester (seventeen weeks) not just one-half of a semester as in the pilot phase, therefore the tutoring time for the experimental phase will be double that of the pilot phase. It is anticipated that the time arrangements for the experimental tutoring period will be much the same as it was in the pilot phase with the exception that sessions will be held in the morning. With some desired changes in the distribution of the machines there could be a considerable increase in the amount of computer tutoring time available to the sixth graders. The desired result of this change will be a proportionally greater gain in mathematics achievement for the sixth grade experimental group than took place in the pilot phase.

DATA

Numerical data were collected on each of the subjects in the study in order to provide the basis for analyses. For each of the secondary students the following data were collected.

1. Ninth grade Stanford Achievement test score (Mathematics subtest): during the experimental phase this test was administered by the project staff at the beginning of the project class, and will be administered as a post test as well. This test will be administered by the project staff to both experimental and control groups.

2. Sex

3. Age

4. Grade level

5. Source mathematics class

6. Score on an attitude scale: for the pilot phase this was a short attitude toward mathematics scale, for the experimental phase this is a more comprehensive scale assessing attitudes toward mathematics, technology and computers on a pre and post basis.

7. During the experimental phase a computer literacy scale will be administered on a pre and post basis.

8. Attendance data on the participants and the control group is being collected for both the pilot and the experimental phases. These data include attendance by period of the day and days per year. These pilot phase data were not yet available at the time of writing of this report.

9. Enrollment data with respect to the classes in which participants choose to enroll, is being collected for both pilot and experimental phases but was not available in time for this report.

For each of the elementary students the following data were collected.

1. Criterion referenced mathematics test score: this is a school district constructed test and will be used for pre and post testing.

2. Stanford Achievement Test (Mathematics subtest)

3. School

4. Class

5. Sex

6. Attitude toward mathematics, technology and computers (experimental phase only)

7. Computer literacy scale - experimental phase only.

8. Attendance data in days per year

Parental reaction to the project was solicited through a locally prepared mailed questionnaire.

During the pilot phase, when possible, data were collected from existing school records. For the experimental phase the project staff will be administering instruments specifically for the project in order to assure more complete data on the participants.

Anectdotal information was (and will be) collected throughout the conduct of the project.

INSTRUMENTS

The following instruments were and are being used for the collection of data in the project.

1. CRT: a school district prepared criterion referenced test in mathematics for sixth grade.

2. Stanford Achievement Test - Mathematics, Intermediate level, Form B, Harcourt Brace and Javanovich, 1973.

3. Stanford Achievement Test - Mathematics, ninth grade level

4. Mathematics attitude scale: locally prepared, used in the pilot phase only.

5. Multi-attitude scale: to assess attitude toward mathematics, technology and computers, prepared by the project staff for use in the experimental phase.

6. Computer literacy scale: prepared by the project staff for the experimental phase.

7. Parent reaction form, prepared by the project staff.

STATISTICAL ANALYSES

For the pilot phase the following analyses were completed.

1. All variables were compiled into frequency distributions using the FREQUENCIES subprogram of the Statistical Package For The Social Sciences - SPSS (Ney, 1975), descriptive statistics were calculated through this process.

2. In the pilot phase, for the secondary students an analysis of covariance (ANCOVA) was completed using the post test on attitude as the dependent variable, sex, age, source mathematics class, and Stanford Acievement Test score as independent variables and the pre-test score on attitude toward mathematics as the covariate. This was done using the SPSS package cited above. A similar analyses will be completed during the experimental phase with a change in the instruments used to collect the data.

3. During the pilot phase, for the sixth grade students an analysis of covariance was also completed. The dependent variable was the post CRT score; age, source class within school, school and experimental or control group were independent variables and the pre CRT score was the covariate. Similar analyses will be completed during the experimental phase.

RESULTS - ELEMENTARY

Tables 1 through 3 present data that resulted from pre-testing of the sixth grade students. Because of the method of choosing the experimental and control groups one would expect the two groups to be quite different on this variable. It can be seen that there was in fact considerable difference in the means for the experimental and control groups (means of 24.3 and 45.5 respectively) on this variable. Recall that the experimental group is made up of sixth grade students who are identified as having difficulty in mathematics and the control group is a random sample of the remaining students (after selecting the experimental group) in the sixth grades of the two schools. This built in difference is the reason the pre-CRT test scores were used as a covariate in the statistical analysis of the post-test scores. Using Fisher's-t test for difference between means the difference between the pre-test means is significant at less than the .01 level ($t = 4.287$, $df = 52$).

(text continued on page 24)

TABLE 1. Frequency distribution of pre-test score on criterion referenced (CRT) mathematics test administered October, 1980 for the pilot phase experimental group sixth grade students.

PRE CRT SCORE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
-0	2	8.0	8.0	8.0
4.	1	4.0	4.0	12.0
12.	3	12.0	12.0	24.0
16.	1	4.0	4.0	28.0
20.	4	16.0	16.0	44.0
24.	1	4.0	4.0	48.0
28.	5	20.0	20.0	68.0
32.	3	12.0	12.0	80.0
40.	3	12.0	12.0	92.0
44.	1	4.0	4.0	96.0
48.	1	4.0	4.0	100.0
TOTAL	25	100.0	100.0	

MEAN	24.320	STD ERR	2.622	MEDIAN	26.400
MODE	28.000	STD DEV	13.111	VARIANCE	171.893
KURTOSIS	-.512	SKEWNESS	-.193	RANGE	48.000
MINIMUM	-0	MAXIMUM	48.000	SUM	608.000
C.V. PCT	53.910	.95 C.I.	18.908	TO	29.732
VALID CASES	25	MISSING CASES	0		

TABLE 2. Frequency distribution of post-test score on criterion referenced (CRT) mathematics test administered in late May, 1981 for a random sample of sixth graders (designated as the control group) during the pilot phase.

PRE CRT Score	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
4.	1	3.4	3.4	3.4
16.	3	10.3	10.3	13.8
20.	1	3.4	3.4	17.2
24.	2	6.9	6.9	24.1
28.	3	10.3	10.3	34.5
36.	2	6.9	6.9	41.4
40.	1	3.4	3.4	44.8
44.	1	3.4	3.4	48.3
48.	1	3.4	3.4	51.7
52.	1	3.4	3.4	55.2
56.	1	3.4	3.4	58.6
60.	1	3.4	3.4	62.1
64.	4	13.8	13.8	75.9
68.	5	17.2	17.2	93.1
72.	1	3.4	3.4	96.6
76.	1	3.4	3.4	100.0
TOTAL	29	100.0	100.0	

MEAN	45.517	STD ERR	3.992	MEDIAN	48.000
MODE	68.000	STD DEV	21.499	VARIANCE	462.187
KURTOSIS	-1.370	SKEWNESS	-.270	RANGE	72.000
MINIMUM	4.000	MAXIMUM	76.000	SUM	1320.000
C.V. PCT	47.232	.95 C.I.	37.340	TO	53.695
VALID CASES	29	MISSING CASES	0		

TABLE 3. Frequency distribution of pre-test score on criterion referenced (CRT) mathematics test administered October, 1980 of combined experimental and control group sixth grade students during the pilot phase.

PRE CRT Score	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
-0	2	3.7	3.7	3.7
4.	2	3.7	3.7	7.4
12.	3	5.6	5.6	13.0
16.	4	7.4	7.4	20.4
20.	5	9.3	9.3	29.6
24.	3	5.6	5.6	35.2
28.	8	14.8	14.8	50.0
32.	3	5.6	5.6	55.6
36.	2	3.7	3.7	59.3
40.	4	7.4	7.4	66.7
44.	2	3.7	3.7	70.4
48.	2	3.7	3.7	74.1
52.	1	1.9	1.9	75.9
56.	1	1.9	1.9	77.8
60.	1	1.9	1.9	79.6
64.	4	7.4	7.4	87.0
68.	5	9.3	9.3	96.3
72.	1	1.9	1.9	98.1
76.	1	1.9	1.9	100.0
TOTAL	54	100.0	100.0	

MEAN	35.704	STD ERR	2.841	MEDIAN	30.000
MODE	28.000	STD DEV	20.877	VARIANCE	435.835
KURTOSIS	-.927	SKEWNESS	.326	RANGE	76.000
MINIMUM	-0	MAXIMUM	76.000	SUM	1928.000
C.V. PCT	58.472	.95 C.I.	30.005	TO	41.402
VALID CASES	54	MISSING CASES	0		

TABLE 4. Frequency distribution of post-test score on criterion referenced (CRT) mathematics test administered in late May, 1981 for the pilot phase experimental group sixth grade students.

Post CRT Test	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
4.	1	4.0	4.0	4.0
12.	2	8.0	8.0	12.0
16.	1	4.0	4.0	16.0
23.	1	4.0	4.0	20.0
28.	1	4.0	4.0	24.0
32.	1	4.0	4.0	28.0
36.	2	8.0	8.0	36.0
44.	2	8.0	8.0	44.0
52.	2	8.0	8.0	52.0
64.	5	20.0	20.0	72.0
72.	4	16.0	16.0	88.0
76.	1	4.0	4.0	92.0
88.	1	4.0	4.0	96.0
92.	1	4.0	4.0	100.0
TOTAL	25	100.0	100.0	

MEAN	50.200	STD ERR	4.995	MEDIAN	53.000
MODE	64.000	STD DEV	24.973	VARIANCE	623.667
KURTOSIS	-.967	SKEWNESS	-.275	RANGE	88.000
MINIMUM	4.000	MAXIMUM	92.000	SUM	1255.000
C.V. PCT	49.748	.95 C.I.	39.892	TO	60.508
VALID CASES	25	MISSING CASES	0		

TABLE 5. Frequency distribution of post-test score on criterion referenced (CRT) mathematics test administered in late May, 1981 of control group of sixth grade students during the pilot phase. Eight of the twenty-nine cases were from Columbine Elementary School, twenty-one were from Spangler Elementary School.

POST CRT TEST	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
16.	3	10.3	10.3	10.3
20.	1	3.4	3.4	13.8
28.	2	6.9	6.9	20.7
36.	2	6.9	6.9	27.6
48.	1	3.4	3.4	31.0
56.	1	3.4	3.4	34.5
60.	3	10.3	10.3	44.8
64.	1	3.4	3.4	48.3
68.	2	6.9	6.9	55.2
72.	5	17.2	17.2	72.4
76.	1	3.4	3.4	75.9
80.	2	6.9	6.9	82.8
84.	1	3.4	3.4	86.2
88.	1	3.4	3.4	89.7
92.	1	3.4	3.4	93.1
96.	1	3.4	3.4	96.6
99.	1	3.4	3.4	100.0
TOTAL	29	100.0	100.0	

MEAN	59.828	STD ERR	4.694	MEDIAN	67.250
MODE	72.000	STD DEV	25.276	VARIANCE	638.862
KURTOSIS	-.864	SKEWNESS	-.477	RANGE	83.000
MINIMUM	16.000	MAXIMUM	99.000	SUM	1735.000
C.V. PCT	42.248	.95 C.I.	50.213	TO	69.442
VALID CASES	29	MISSING CASES	0		

TABLE 6. Frequency distribution of post-test score on criterion referenced mathematics test administered in late May, 1981 of combined experimental and control group sixth grade students during the pilot phase.

POST CRT TEST	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
4.	1	1.9	1.9	1.9
12.	2	3.7	3.7	5.6
16.	4	7.4	7.4	13.0
20.	1	1.9	1.9	14.8
23.	1	1.9	1.9	16.7
28.	3	5.6	5.6	22.2
32.	1	1.9	1.9	24.1
36.	4	7.4	7.4	31.5
44.	2	3.7	3.7	35.2
48.	1	1.9	1.9	37.0
52.	2	3.7	3.7	40.7
56.	1	1.9	1.9	42.6
60.	3	5.6	5.6	48.1
64.	6	11.1	11.1	59.3
68.	2	3.7	3.7	63.0
72.	9	16.7	16.7	79.6
76.	2	3.7	3.7	83.3
80.	2	3.7	3.7	87.0
84.	1	1.9	1.9	88.9
88.	2	3.7	3.7	92.6
92.	2	3.7	3.7	96.3
96.	1	1.9	1.9	98.1
99.	1	1.9	1.9	100.0
TOTAL	54	100.0	100.0	

MEAN	55.370	STD ERR	3.452	MEDIAN	63.000
MODE	72.000	STD DEV	25.365	VARIANCE	643.407
KURTOSIS	-.949	SKEWNESS	-.347	RANGE	95.000
MINIMUM	4.000	MAXIMUM	99.000	SUM	2990.000
C.V. PCT	45.811	.95 C.I.	48.447	TO	62.294
VALID CASES	54	MISSING CASES	0		

TABLE 7. Analysis of Covariance table for post-test on criterion referenced mathematics test (CRT) for sixth grade students. The covariate was the pre-test on the criterion referenced mathematics test (PCRT). Independent variables were the source elementary school (SCHOOL), source class in the elementary school (CLASS) and experimental or control group (GROUP).

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

PCRT
BY SCHOOL
CLASS
GROUP
WITH CRT

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	14137.261	1	14137.261	36.387	.001
CRT	14137.261	1	14137.261	36.387	.001
MAIN EFFECTS	2712.1[illegible]	5	542.432	1.396	.250
SCHOOL	483.498	1	483.498	1.244	.272
CLASS	1960.894	3	653.631	1.682	.189
GROUP	280.078	1	280.078	.721	.402
2-WAY INTERACTIONS	1770.331	6	295.055	.759	.606
SCHOOL CLASS	82.080	2	41.040	.106	.900
SCHOOL GROUP	1025.343	1	1025.343	2.639	.113
CLASS GROUP	212.896	3	70.965	.183	.907
3-WAY INTERACTIONS	156.049	1	156.049	.402	.530
SCHOOL CLASS GROUP	156.049	1	156.049	.402	.530
EXPLAINED	18775.802	13	1444.292	3.717	.001
RESIDUAL	13598.198	35	388.520		
TOTAL	32374.000	48	674.458		

54 CASES WERE PROCESSED.
5 CASES (9.3 PCT) WERE MISSING.

FIGURE 2. Cumulative relative frequency distribution of pre and post test scores on the criterion referenced mathematics test for the experimental and control group sixth grade students in the pilot phase.

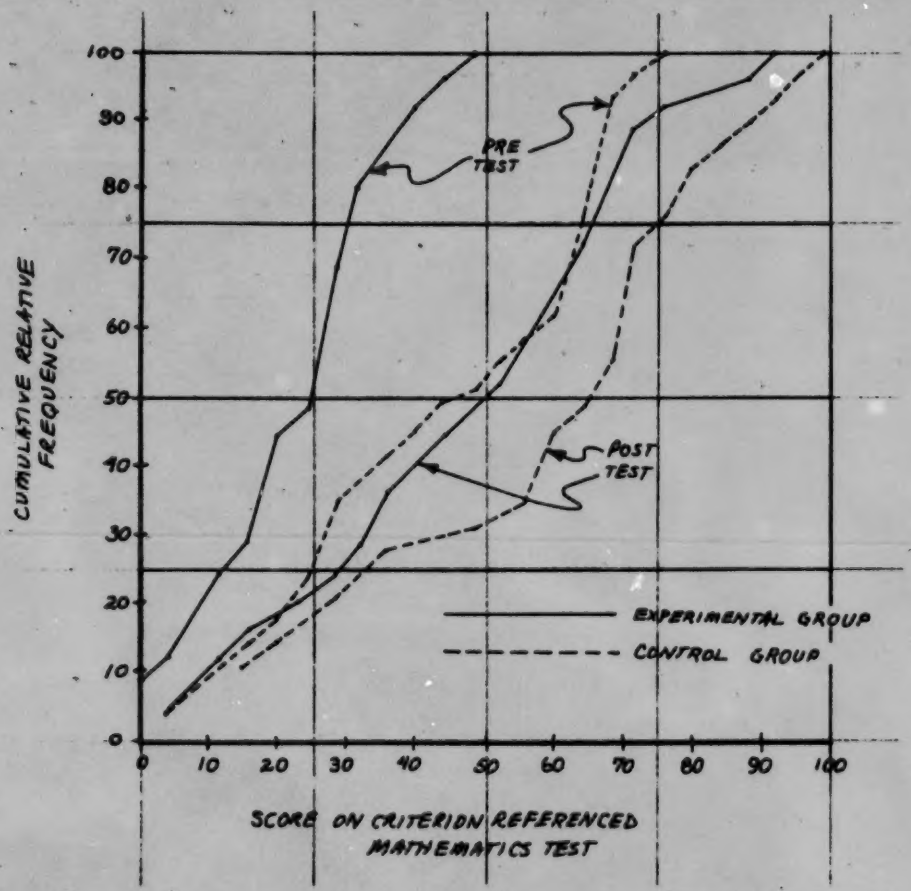

Table 3 combines the experimental and control groups. This table is included for information purposes only.

Tables 4 through 6 present data on the post-CRT test scores for the two groups of sixth graders. Considering the mean post-test scores for the two groups (50.2 for the experimental group and 59.8 for the control group. there is not nearly so much difference as was obtained on the pre-test. However a comparison of the means alone is not sufficient for checking differences. Table 7 however presents the analysis of covariance (ANCOVA) of the post-test scores. It can be seen that the ANCOVA indicates there is no significant difference between the post-test means for either main effects or interactions. Overall this result may seem disturbing given the purposes of the project. As is often the case however statistical tests do not always tell the complete story. Consider Figure 2. Figure 2 is a cumulative frequency distrubution of the pre- and post-tests for both the experimental and control groups of sixth graders. This figure graphically exhibits the "progress" of the experimental group in increasing their mathematical skill in relation to similar "progress" of the control group.

DISCUSSION OF RESULTS - ELEMENTARY

The primary question is, "Does the design measure the degree of the students progress in mathematical skill and is this progress due to the treatment?" Under the circumstances the answer to this question could be yes or no. Admittedly there are some "problems" with the study as it stands but the main purpose of the pilot was to identify these "problems" and accomodate them prior to the experimental phase. Some of the problems in the pilot phase were the following.

1. The CRT as a pre-test was administered seven months prior to the beginning of the tutoring period. This problem was caused by an attempt to do as little special testing of the sixth grade students as possible. This will be overcome in the experimental phase by testing all sixth grader stundets in the two elementary schools at the beginning of the spring semester, 1982. The proximity of the pre-test and the onset of the treatment will therefore coincide.

2. The post-test was administered prior to the completion of the tutoring treatment. This was another case of relying on the regular district testing of the sixth graders rather than special testing for the project. This will be overcome in the experimental phase by special testing of the sixth graders in the last week of the spring semester 1982, irrespective of when the district conducts its testing (if this is satisfactory to the schools involved and the students are not overtested by that time).

3. Because of points 1 and 2 above the testing of the sixth graders did not coincide with the treatment.

4. A question arises as to the types of mathematical skills that should be assessed as a part of the project. The policy in the pilot was to rely on the content emphasis which was used in the regular school program. The project staff are examining this policy for the experimental phase. It is a clear possibility that there are many skills being encouraged within the project that are not a part of the regular testing conducted within the school district. The project staff feel that this situation will become more common as microcomputers become more commonly integrated into regular instruction and is one area that should be the focus of research in the future.

5. One could argue that the apparent "progress" as exhibited by Figure 2 is due in part to regression effect since the experimental group was an "outlying" group and therefore had a greater chance of gain than did the control group. Unfortunately there is no way of determining the level of regression effect given the data available.

6. One could be disturbed at the apparent lack of post-test difference between the two groups based on the ANCOVA in Table 7. This test is but one statistical test and such single tests frequently do not give one a balanced view of the entire situation.

7. The treatment time for the changes that did result was only ten hours over a seven week period.

8. Microcomputers were used on the average of only about twenty minutes per week for the seven weeks (total of about two and one-third hours) for each sixth grade student in the experimental group in the tutoring situation.

9. Almost no commercial software was available for use on the microcomputers during the time the tutoring took place. This was partially a difficulty associated with the delivery of equipment (see a discussion of this elsewhere in this report).

10. Lastly the project staff feel that the following should be kept in mind. These data were generated in the pilot phase of the project, the purpose of which was to test procedures used in the project rather than effect significant changes in achievement.

RESULTS - SECONDARY

The results of the data collection and anlyses for the high school students are presented in Tables 8 through 12 and in Figures 3 and 4. Table 8 gives the frequency distribution of the ages of the high school students. The average age of the participants was just under sixteen years. The age of four of the subjects was not available.

Of the twenty-nine high school students in the project eleven were female, eighteen were male, seventeen had completed Algebra I, and twelve had completed Algebra II.

Table 9 is a frequency distribution of the pre-test stanine scores on the Stanford Achievement mathematics subtest. The mean stanine score was about 6.5 with a standard deviation of about 1.2. All the students satisfied the selection criterion of a stanine score of at least five. The Stanford test was administered in the student's ninth grade year so in some cases the test score was up to two and one half years old. Figure 3 is a histogram of the distribution of the Standford stanine scores. The majority of the students (82.8%) had stanine scores of five, six or seven.

(text continued on page 33)

TABLE 8. Frequency distribution of ages of twenty-five students in the pilot phase high school experimental group, four students did not report their age.

Age	Frequency	Rel. Frequency	Cum. Rel. Freq.
15	7	28	28
16	12	48	76
17	6	24	100
Total	25	100	

Mean = 15.96 Mode = 16 Median = 16.54
Variance = 0.207 St. Dev. = 0.52

TABLE 9. Frequency distribution of pre-test stanine scores on the Stanford Achievement Test (mathematics subtest) for the twenty-nine students in the pilot phase high school experimental group. The test was administered in the ninth grade for each of the students.

STANINE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
5.	7	24.1	24.1	24.1
6.	7	24.1	24.1	48.3
7.	10	34.5	34.5	82.8
8.	3	10.3	10.3	93.1
9.	2	6.9	6.9	100.0
TOTAL	29	100.0	100.0	

MEAN	6.517	STD ERR	.220	MEDIAN	6.550
MODE	7.000	STD DEV	1.184	VARIANCE	1.401
KURTOSIS	-.452	SKEWNESS	.372	RANGE	4.000
MINIMUM	5.000	MAXIMUM	9.000	SUM	189.000
C.V. PCT	18.165	.95 C.I.	6.067	TO	6.968
VALID CASES	29	MISSING CASES	0		

FIGURE 3. Histogram of distribution of pre-test stanine scores on Stanford Achievement mathematics subtest for the twenty-nine students in the pilot phase high school experimental group.

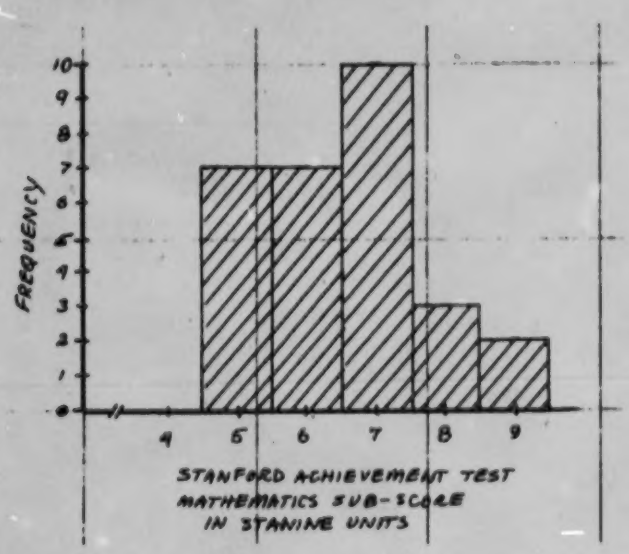

TABLE 10. Frequency distribution of scores on the pre-test on attitude toward mathematics for the twenty-nine students in the pilot phase high school experimental group. This test was administered in February, 1981.

ATTITUDE PRETEST	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
0	4	13.8	13.8	13.8
10.	2	6.9	6.9	20.7
11.	2	6.9	6.9	27.6
14.	1	3.4	3.4	31.0
17.	5	17.2	17.2	48.3
18.	5	17.2	17.2	65.5
19.	3	10.3	10.3	75.9
20.	3	10.3	10.3	86.2
21.	2	6.9	6.9	93.1
22.	1	3.4	3.4	96.6
24.	1	3.4	3.4	100.0
TOTAL	29	100.0	100.0	

MEAN	15.034	STD ERR	1.300	MEDIAN	17.600
MODE	17.000	STD DEV	7.002	VARIANCE	49.034
KURTOSIS	.710	SKEWNESS	-1.315	RANGE	24.000
MINIMUM	0	MAXIMUM	24.000	SUM	436.000
C.V. PCT	46.576	.95 C.I.	12.371	TO	17.698
VALID CASES	29	MISSING CASES	0		

TABLE 11. Frequency distribution of scores on the post-test on attitude toward mathematics for the twenty-nine students in the pilot phase high school experimental group. This test was administered in May, 1981.

ATTITUDE POST TEST	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
-6.	1	3.4	3.4	3.4
-5.	1	3.4	3.4	6.9
-4.	2	6.9	6.9	13.8
-3.	2	6.9	6.9	20.7
-2.	6	20.7	20.7	41.4
-1.	2	6.9	6.9	48.3
0	1	3.4	3.4	51.7
1.	3	10.3	10.3	62.1
3.	4	13.8	13.8	75.9
4.	4	13.8	13.8	89.7
5.	1	3.4	3.4	93.1
10.	1	3.4	3.4	96.6
14.	1	3.4	3.4	100.0
TOTAL	29	100.0	100.0	

MEAN	.724	STD ERR	.820	MEDIAN	0
MODE	-2.000	STD DEV	4.415	VARIANCE	19.493
KURTOSIS	1.800	SKEWNESS	1.099	RANGE	20.000
MINIMUM	-6.000	MAXIMUM	14.000	SUM	21.000
C.V. PCT	609.697	.95 C.I.	-.955	TO	2.404
VALID CASES	29	MISSING CASES	0		

FIGURE 4. Cumulative relative frequency distribution of pre and post test on attitude toward mathematics for the experimental high school students in the pilot phase.

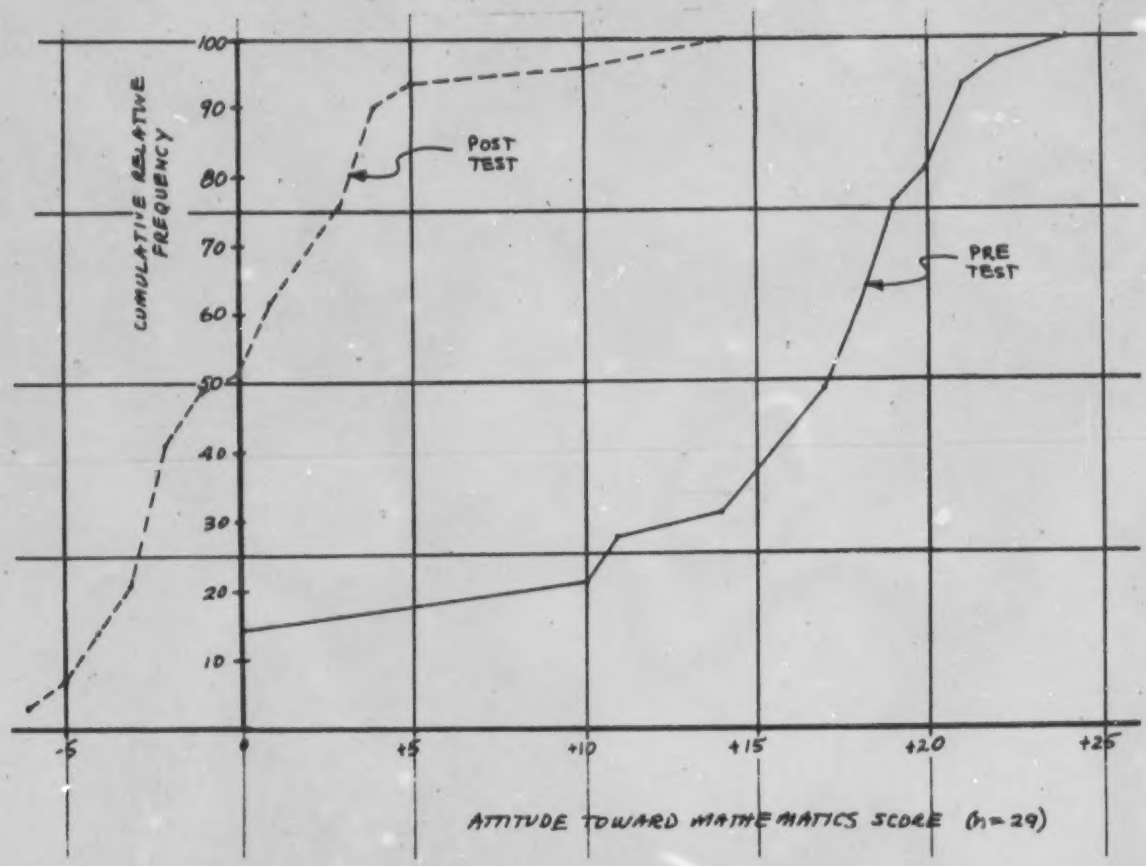

TABLE 12. Analysis of Covariance table for post-test on attitude toward mathematics (FSCORE) for the experimental group of high school students in the pilot phase. The covariate was the pre-test on the pre-test on attitude toward mathematics (PSCORE). Independent variables were age (AGE), sex (SEX) and source mathematics class (SOURCE). Note that eleven of twenty-nine cases had incomplete data.

* * * * * * * * ANALYSIS OF VARIANCE * * * * * * * *

PSCORE
BY AGE
SEX
SOURCE MATH CLASS SOURCE
WITH FSCORE

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
COVARIATES	10.283	1	10.283	.760	.406
FSCORE	10.283	1	10.283	.760	.406
MAIN EFFECTS	50.744	3	16.915	1.250	.348
AGE	6.702	1	6.702	.495	.499
SEX	3.496	1	3.496	.258	.623
SOURCE	19.410	1	19.410	1.434	.262
2-WAY INTERACTIONS	84.594	3	28.198	2.084	.173
AGE SEX	71.753	1	71.753	5.302	.047
AGE SOURCE	42.917	1	42.917	3.171	.109
SEX SOURCE	11.059	1	11.059	.817	.390
3-WAY INTERACTIONS	1.692	1	1.692	.125	.732
AGE SEX SOURCE	1.692	1	1.692	.125	.732
EXPLAINED	147.313	8	18.414	1.361	.327
RESIDUAL	121.798	9	13.533		
TOTAL	269.111	17	15.830		

29 CASES WERE PROCESSED.
11 CASES (37.9 PCT) WERE MISSING.

Table 10 gives the results of the pre-test on attitude toward mathematics for the high school students. This test was locally prepared and had a range of possible scores of -20 to 20. A low (nearer to -20) score was to indicate a negative attitude toward mathematics and a high score (nearer to 20) was to indicate a positive attitude. This pre-test was administered in late February, 1981. The mean score was about fifteen indicating a positive attitude toward mathematics on the average, however the standard deviation was 7 which indicates a wide variation in the attitude scores for the twenty-nine students. None of the students had a negative attitude but four did exhibit a neutral attitude by scoring zero.

The secondary students were post-tested on their attitude toward mathematics using the same scale that was used at the pre-test. This post-test was administered in May, 1981. Table 11, giving the results of the post-testing on attitude, indicates a mean attitude score of 0.7 and a standard deviation of 4.4. The post-test mean attitude score dropped from the pre-test, the variation narrowed and some of the students scored in the negative range on the post-test.

Table 12 presents the results of the ANCOVA test on the post-test on attitude toward mathematics for the high school students. The covariate was the pre-test on attitude toward mathematics the independent variables were age, sex and source mathematics class. The Stanford mathematics test score was not used in this analysis because of the length of time since the administration of that test. Eleven of the twenty-nine cases had missing data therefore there were only eighteen of the cases included in the analysis. With only eighteen cases the results of the ANCOVA are seriously questionable. Only one of the tests within the ANCOVA resulted in significance ($p < .05$) and this was the two way interaction between age and sex. If this result was present with a greater number of cases this might have been a point of departure for further investigation but under the circumstances little can be said about this result. The main effects of sex, age and source mathematics class were not significant but once again, with the few number of cases, little discussion of consequence is appropriate.

Figure 4 presents a cumulative relative frequency distribution curve of the pre- and post-testing on attitude toward mathematics for the high school students. This curve graphically illustrates the apparent negative attitude change on this test.

An extensive discussion of the results in Table 12 and Figure 4 follow in the next section of this report.

** DISCUSSION OF RESULTS - SECONDARY

The previous section of this report gave the results for the apparent attitude change on the part of the high school students in the pilot phase. This section discusses those results.

On the surface there was a negative attitude change on the part of the high school students. The project staff feel that there are many factors which caused this apparent change, if in fact there was a true change.

1. The ANCOVA, a questionable procedure because of the few cases, indicated that any change was not significant. To overcome the problem of insufficient cases complete participation in testing is the goal for the experimental phase. The staff feel this will be achieved.

2. The primary time of "treatment" of the high school students was during the pre-tutorial period. This period was to have had extensive time on the microcomputers and in study of the mathematical difficulties of the sixth graders. The microcomputers had been ordered in what was considered to be time to be delivered for the beginning of the project classes. Due to many factors, delivery of the equipment did not take place until after the pre-tutorial period ended. Thus during the eight weeks of this period the high school students had available, for only part of the time, one machine that had been loaned to the project by the St. Vrain Schools. This delay in receipt of the equipment caused much dissatisfaction in the students. The school principal felt the need to come to the classes and assure the students that if any of them wanted to drop the class they could do so without discredit. Negative feelings were caused because of this problem. (See the section of this report titled

Difficulties Encountered for a more lengthy discussion of this problem.)

3. The instrument to assess the students attitude toward mathematics was locally prepared and was very short. The shortness was to relieve the students of completing a lengthy test because the students were known for their dislike of completing tests. This instrument has been replaced for the experimental phase by a more lengthy test covering technology and computers in addition to mathematics.

4. The students were observed to be making remarks about having to complete the attitude measure. Such comments as "here we go again" or "OH! Not this again." were common during the post-testing session. This was true even though the instrumnent was very short. This attitude undoubtedly had a negative influence on the attitude scores. A more positive attitude toward testing is expected in the experimental phase.

5. The post-test was administered within about eleven weeks of the pre-test. While this may seem to be sufficient time to overcome pre-test interference in the post-test this was evidently not the case. Many of the students clearly had recalled in detail the pre-test when they took the post-test and they voiced their dissatisfaction at having to take the test again. (See number four above.) The proximity of pre- and post-testing will not be a problem in the experimental phase because there will be approximately thirty-five weeks between the two testings.

6. The project staff feel that the problems brought out in numbers four and five above reflect high interest in the content of the project on the part of the high school students. Students remarked that they would much prefer to spend time on the microcomputers and on their usual class acivities rather than taking tests. This fact alone causes the staff to feel that the negative change indicated by comparing the pre- and post tests is invalid. During the experimental phase the amount of time for "regular class activities" will be very adequate to overcome this problem.

7. There were many of the students in the pilot phase who would have taken the opportunity to participate in the project during the experimental phase had they been given the chance. This is known from comments given by the students themselves and by the results of the survey of parents. This again argues against the validity of the post-test results. Several of the pilot phase students come to visit in the project classes during the fall, 1981, a full six months after their participation ceased. This seems to indicate high interest on the students' part.

8. The predesigned measure of success of the project relative to the project objectives was continued enrollment in mathematics and science classes after participation in the project. The attitude measure was included as something above what was proposed in the original grant proposal. This change in attitude was not to be the primary measure of success of the high school part of the project. We do feel that this is important however and will carry out a more extensive attitude assessment in the experimental phase.

9. The staff are still collecting data on the enrollment patterns of the pilot phase high school participants but these data were not available in time for this report. Thus data for the true measure of success for the pilot phase high school students were not available for this report. This delay may cause some difficulties one year from now when the experimental phase report is being written. The needed data will be available during the time the final report must be written instead of prior to that time. The difficulty will be in collecting the data with no official staff on the project. This problem is being adddressed but the solution is not known at this time.

10. Lastly, be reminded that these data were generated in the pilot phase of the project, the purpose of which was to test procedures used in the project rather than effect significant change in the participants.

** MEETING WITH CONSULTANTS

On July 16 and 17, 1981 a meeting took place in Boulder, Colorado between the project staff and four outside consultants. The consultants involved were Dr. Lud Braun of the State University of New York at Stony Brook, Ms. Cathy Gilbert of the School of Education, Stanford University, Mr. Randy Wallace of the St. Vrain Public Schools, Longmont, Colorado, and Mr. Richard Camfield a computer graphics expert from Castle Rock, Colorado

Two weeks prior to the meeting, each of the consultants was provided with a rough draft of this report and the narrative description of the project as contained in the original grant request. They were asked to read these carefully prior to the upcoming meeting noting any questions and suggestions. The purpose of the meeting was to obtain outsiders' views of the first year of the project and to obtain suggestions for changes prior to the time the experimental phase began.

The meeting consisted of an oral and pictorial overview of the project through that date and a detailed discussion of each aspect of the project. Questions were clarified as they arose and for those areas where it was appropriate, suggestions were also elicited with respect to alternatives for accomodating these suggestions. The project staff felt that the meeting was very profitable for the second year of the project and thank the persons involved for taking their time to assist.

There was extensive discussion of many aspects of the project and the rough draft of this report. From this discussion the following recommendations appeared to be the areas of greatest concern: (not in priority order)

1. The project staff should make an investigation into the reasons for the predominance of females in the experimental group in the high school. It was felt if there were identifiable reasons and causes of this phenomena that some effort to encourage these phonomena in schools might cause a greater enrollment of females in mathematics and science courses. The project staff feel that this is an excellent suggestion but that given the limited time and resources available within the grant this suggestion may not be feasable to implement as part of the project. Any effort in this area would detract from the primary purposes of the project as funded. We do feel however that this is an important area to pursue in the future.

2. The project should extend as much as possible the amount of computer tutoring time available to the sixth graders. It was felt that if this were done that there would be far greater potential for more significant increase in the sixth graders mathematics achievement. The project staff had this concern prior to the consultant meeting and have acted on this recommendation by attempting changes in the 1981-82 year to accomodate this suggestion. The section of this report titled Analysis of Computer Time contains an extensive discussion of this plan (see below).

3. The project staff should expand the scope of testing of subjects to include problem solving, self-image, computer literacy, and attitudes toward technology and computers. The project staff have acted on this recommendation relative to attitude scales and computer literacy and will be using a these scales in 1981-82. With respect to self-image and problem solving, we have been unable to locate satisfactory instruments for these but are continuing to search in these areas.

ANALYSIS OF COMPUTER TUTORING TIME

One of the primary suggestions for change in procedures for the experimental phase, made by project consultants at their summer 1981 meeting was to increase the amount of computer tutoring time available to the sixth graders. The project staff have made a thorough analysis of available options to accomodate this suggestion.

The first step in this analysis was the identification of the assumptions on which any decision should be based. This resulted in the following list:

1. Each of the three schools should have at least one machine based in the school during the tutoring period.

2. The distribution of machines in the elementary schools during the tutoring period should be as close to the distribution of the number of students in the experimental groups in these schools (about 2:1).

3. The total number of useable student computer hours should be maximized. This is a combination of both elementary and secondary student computer hours.

4. Monitors should not be transported because they are heavy, bulky, electronically sensative and if dropped the picture tube could explode and therefore would be dangerous.

5. Transporting the computer consoles and disk drives is feasable.

6. The top priority during the tutoring session is change in the mathematical achievement of the sixth graders and secondly is the continued development of the secondary students competence on the computers.

Subsequent to establishing these assumptions all combinations of "fixed" station machines and "transported" machines were listed. Each of these combinations was analyzed with respect to the number of elementary computer tutoring hours and secondary computer hours provided by the distribution. The distribution which came nearest to satisfying the above six criteria was the following:

1. Four machines should be stationed at one elementary school.

2. One machine should be stationed at the other elementary school.

3. Four machines should be transported from the high school to the elementary schools each tutoring session.

This distribution would allow, after transporting, eight machines in one elementary school, five in the other and four in the high school, a distribution providing a ratio of machines in the elementary school (8:5) of slightly greater than 2:1. (We would prefer to err on the positive side.) This distribution will allow the average number of hours of computer tutoring time to increase from .25 hours per week during the pilot phase to .54 hours per week during the experimental phase. At the same time the secondary students will see a decline in the number of non-tutoring computer hours during the tutoring period from .54 hours per week per student in the pilot phase to .33 hours per week per student during the experimental phase. However the secondary students will already have had an average of 1.33 hours per week per student of on-line computer time during the pre-tutoring period for a full eighteen weeks prior to the beginning of the experimental tutoring phase. Thus the secondary students will have had extensive computer experience and the decrease in computer time available to them during the tutoring phase will have less effect overall than if the distribution were such that lesser computer tutoring time were available to the sixth graders. The proposed distribution will increase sixth graders computer tutoring time by 150% but decrease the secondary students computer time by only 39%. A reasonable trade-off it seems.

Specifically, under the proposed distribution:

Elementary computer tutoring time	.54 hrs/student/week
Secondary computer time	.33 hrs/student/week
Overall	.87 hrs/student/week

Under the distribution used in the pilot phase:

Elementary computer tutoring time	.21 hrs/student/week
Secondary computer time	.54 hrs/student/week
Overall	.76 hrs/student/week

However the proposed arrangement has a serious problem. This problem is that four machines must be transported to the elementary schools each tutoring session. In order to do this the staff feel it is necessary to purchase carrying cases for the four machines ($110 each) and, because of assumption number four, purchase eight more monitors ($400 each). The difficulty we face is that these funds ($4440) are not available in the original grant. Because of this a supplimentary funds request has been prepared of which the $4440 is the major part of the supplimentary request.

** PARENT REACTION

In early June, 1981 a short questionnaire (see appendix) concerning the project was sent to parents of participants in the pilot phase. Fifty-four of the questionnaires were sent, twelve responses were received. The low return rate was felt to be because of the lateness of the mailing, however it was felt to be necessary to sample parent reaction after the pilot phase was complete. Thus the school year had already terminated when the questionnaires were mailed. No attempt was made to follow-up on parents who did not respond because of the difficulty in contacting anyone after the school year was completed. It is clear that if we are to get a greater return in the experimental phase, parents will have to be contacted earlier. A summary of responses that were received follows. Responses are not divided with respect to elementary and secondary responses.

Seventy-five percent of parents indicated an increase in their child's interest in mathematics since participating in the project. Twenty-five percent indicated not change. No parent indicated less interest on their child's part.

Forty-two percent of parents responded that the project increased their child's mathematics skills greatly, half responded that their child's mathematics skills improved and only one parent indicated that their child had no change in mathematics skills.

One half of the parents said that the amount of time spent on the microcomputers was about right and one-third said there was too little time spent on the microcomputers. One parent was apparently torn between these two alternatives and none of the parents indicated there was too much time spent on the microcomputers.

Only one parent indicated that their child would not participate in the project again if given the opportunity. This same parent said that their child had a negative reaction to participation in the project. No specifics were given in this case.

Written notes at the end of the questionnaire included the following:

> "XXX had trouble with math! I think this program helped him very much. It was good they had a program like this for him to participate in."
>
> "Not enough challenge."
>
> "I was somewhat apprehensive about the benefit this class would provide YYY. He seemed very interested and it appears to have been a boost to his math interest. - Thanks"
>
> "Thank you" (no specifics given)

It appears that parents felt an increase in interest in mathematics was gained be their children through participation in the project. Most felt there was an increase in their child's skill in mathematics. There was a close split concerning the amount of time spent on the microcomputers slightly favoring adequate time. More time would likely have provided the challenge one respondent desired. It is heartening tc the porject staff that all but one parent indicated their child would "do it again" if given the opportunity and that the same proportion felt positively about the project overall.

Our conclusion from this survey is that the parents think their children had a successful experience in the project and the project promoted positive attitudes as well as increased skill in mathematics.

"FALL OUT" FROM THE PROJECT

There have been some remarkable events that have taken place due to the presence of the nine machines in the schools. The subtlest of these have been the quiet inquiries into "what's happening," "when can I get involved?", or "When will these machines be vailable for others to use?" Many such comments have been heard throughout the project and it seems that this interest was first directed only to the equipment it then the extended to the project itself. These types of comments were relatively common during the pilot phase and it appears that they are continuing in the experimental phase. Several newspaper articles have appeared on the project (see the appendix) and two invited addresses have been given by the project staff. One of these addresses was given to teachers in the St. Vrain Schools by the principal investigator (about forty persons in attendance) and the other was conducted by both the PI and the project director at the 1981 annual meeting of the Colorado Council Of Teachers Of Mathematics (seventy-five persons in attendance). During the first of these two presentations the project director was conducting a workshop for elementary school teachers in the St. Vrain Schools using the equipment from the project.

In addition, during the period April 1, 1981 through September 1, 1981 there were four separate teacher in-service courses on the use of microcomputers using equipment from the project. These courses included nearly 6,500 teacher hours on the equipment. More of these courses are now taking place and more are scheduled. The current estimate of the number of teacher in-service hours using the project equipment to be accumulated over the two years of the grant is close to 15,000 hours. This does not include any "off line" hours the teachers will have spent on activities directly associated with the in-service sessions. Conservatively estimating one hour "offline" for every one hour "on line" this accumulated teacher in-service hours will become 30,000. Persons involved in these courses span the K-12 grade levels and include administrators, counselors, media specialists and other professional staff persons associated with schools. By our estimate nearly ten school districts have been involved. The primary instructors in these sessions have been the principal investigator and Mr. Randy Wallace, Mathematics Coordinator of the St. Vrain Schools.

This amount of inservice instruction will undoubtedly prove to have a greater effect on instruction than the project classes. The interest, activity and desire for incorporating microcomputers in instruction generated by the project in this area is tremendous, even though this was not the original purpose of the project.

The project staff have wondered about the overall effect of the "mere presence of microcomputers" in a classroom, school or school district. We feel that a case study of the changes caused by the infusion of this technology into a fertile medium (classroom/school/school system amenable to its presence) might be very interesting and yeild valuable data on the evolution of school programs in a rapidly changing technological era.

** DIFFICULTIES ENCOUNTERED

The difficulties encountered by the project have been numerous. Any person expects problems but attempts to minimize these through careful planning and anticipation. The difficulties mentioned below were not the type that one could anticipate but they are ones that have caused major revisions in original plans. They center around three themes; implementation, equipment and operation.

Implementation difficulties were the following:

1. Several months delay in funding from the announced funding date.

2. Changing of school district midstream.

3. Loss of a project director before implementaion.

4. Complete change of school district central administration before implementation.

The first of these was a contributor to the third. The second was completely unexpected and remains a mystery. the third was reasonable given the first. The fourth was unexpected and ultimately caused approximately two months delay.

Equipment difficulties were not anticipated. It was felt originally that this area would be the simplest to take care of. The difficulty was late delivery of the equipment, completely AFTER the period in the pilot in which the high school students were to have had their instruction on how to use the microcomputers. The problem arose because the implimentation difficulties mentioned above caused a three month delay in ordering equipment and because vendors did not know the capabilities of equipment which they were selling. Equipment was ordered about three months later than planned. Internal procedures of the university caused a subsequent six week delay, vendor ignorance caused an additional three week delay, coincidence of events caused a three week delay, the inability of the vendor which was awarded the

delivery of any equipment under these circumstances is a wonder. We feel the same way and had to make many changes to accomodate the resulting problems. All the equipment was finally delivered by October 1, 1981 a full month into the experimental phase and ten months after the order was placed. Our recommendation to others is to place orders early, know PRECISELY the capabilities of the equipment to be ordered, be absolutely certain of the internal ordering proceudres of your organization (computer equipment frequently has attached a unique procedure) and have contigency plans for delays.

The primary operational difficulty which has been encountered was caused by the non-appearance of the announcement of the project class in the fall, 1981 schedule for the high school. Because of this there were only four, of a desired thirty, students in the project class for the experimental phase. This caused much searching to find the additional twenty-six students so the project classes could proceed. Ultimately thirty-four students were recruited but the degree to which they satisfy the established selection criteria is still being determined. It is known that they do not satisfy these criteria and this in turn is causing difficulties in identifying a control group. It is not a problem that is insurmountable but it does cause effort to be expended that would be better spent on other things.

The project staff are not interested in placing blame for any of these difficulties. Our main purpose in mentioning them is to help others who may be attempting to implement a project in another setting. Maybe they can benefit from our experience. We anticipated that we would encounter ruts on the road to putting this project into practice but we did not anticipate chasms.

** CERTIFICATES OF COMPLETION

After the completion of the pilot phase each of the participants (both elementary and high school) were sent a certificate verifying completion of the project. This certificate was included in envelope with the parent reaction form. For the experimental phase these certificates will be revised and given to each of the students who complete the experimental phase. A reproduction of the certificate is contained in apppendix F.

** PROJECT DIRECTOR'S REPORT

I. Fall 1980

The months of November and December, 1980 and January, 1981 were spent largely in taking a written, abstract proposal and forging it into a functioning project that would affect three schools and approximately sixty students. The proposal, as it was in November, specified different personnel and operated in different schools that what was going to be the case. The purposes and procedures of the project had to be translated into practice, and in many cases defined and modified to the environment of the district. Considerable time was spent in working out a myriad of details that are necessary to assure that a program of this sort fuctions smoothly from the day of its inception in the school to guarantee its success. The major areas of preparation were the following:

1. Contacting principals at the three schools: there were five administrators to deal with, including assistant principals. Only one of the five had any knowledge of the project prior to the day the project director walked into their school. This was the case even though the project had been discussed and approved by the school board. Considerable time was spent in explanation, definition, and minutiae, especially in discussions of why they had not been given any prior notice of the project.

2. Explaining the program and getting cooperation from the sixth grade teachers, whose students would be tutored and to those affected by the program at the high school. The program was met with considerable suspicion and lack of support initially. It was necessary to find at least one established person in each building to give support and gain support from others. In particular, one counselor at the high school was especially helpful along these lines.

These first two areas were made much more difficult than necessary because of the lack of communication between the district administration and the school level administration at the beginning of the program.

3. Indentification of students to be included in the project: at the high school level, students were included if they met five criteria (see previous section titled Selection Criteria). Based on these criteria thirty students were selected for the project, eighteen girls and twelve boys. During the first two weeks of the program two girls and one boy dropped from the project for various reasons, one indicating that he did not have enough "brains" to be in the program and the other two saying that they had misinterpreted the purposes of the project. On the elementary level an attempt was made to use the set criteria for selection of the students. Due to the difficulty in obtaining some of the test scores, students were initially selected on the basis of CRT test scores. Students were then randomly selected from those who scored 60% or less on this test. Sixth grade teachers were consulted on some of the specific individual capabilities and difficulties of each student. At Columbine Elementary School seventeen students were selected, eleven boys and five girls, ten students were selected at Spangler Elementary School, eight boys and two girls. One boy was dropped from the twenty-eight students selected because excessive absences made the tutoring useless. Classroom teachers were hopeful that including this student in the program would provide the extra attention needed to change his attendance but this unfortunately did not happen.

4. Decisions concerning the scheduling of project sessions which were acceptable to both the elementary schools (which tend to be dictated by the PE and music schedules) and the high school had to be made.

5. Making arrangements for the space to be used by the project classes and for tutoring: This was especially difficult in one of the elementary schools where all space, including small closets, was being used for either instructional or storage purposes. Time and space arrangements were finally solved with a high, although not complete, degree of satisfaction to all involved. The few difficulties that still remain have been overcome for the experimental phase. The amount of cooperation and compromise by the elementary school teachers in these matters cannot be overstated.

II. Spring 1981 - First Quarter

The first quarter of the actual implementation of the project started on January 26, 1981 and continued through March 20, 1981. The major difficulty during this time (the pilot pre-tutorial period) was lack of equipment. The computers did not arrive until April 3, 1981. There was no equipment available to the project class for the first half of the pre-tutorial period and for the second half there was only one machine available, which was borrowed from another school in the district. This problem caused some of the students to become quite disillusioned about the program, a feeling in some students that had to be combatted throughout the rest of the school year.

During the first quarter time was spent in approximately the following proportions:

50% in tutoring preparation,
40% in study of computers and
10% in administration and testing.

For the study of computers three areas were dealt with, all simultaneously. These areas were:

1. Computer hardware and organization: Under this heading the following items and vocabulary were explained and discussed.

Abacus	CPU	Input	ALU
Cursor	Output	BASIC	ROM
Memory	Binary	RAM	VDU (VDT)
Bit	Compute	Chip	Byte
Digital	Monitor	Program	Language(s)
Word	Diskette	Floppy disk	Disk drive

2. Programming commands: Under this heading, students were introduced to and given demonstrations (since we lacked equipment) on the following programming commmands.

GR	TEXT	COLOR = X	FOR - NEXT
VLIN	IF - THEN	HLIN	NEW
HOME	CALL-936	PRINT	PLOT
REM	LIST	INPUT	LOAD (LOAD XX)
LET	END	SAVE (SAVE XX)	

Variables and variable names were also included, as were the sequential ordering of operations and binary numbers.

3. Social impact of computers: This topic was covered only marginally and included the use of a film on how computers are impacting daily life. This area remains one which will be expanded for the coming year.

The second major area covered during the first quarter was that of tutoring preparation. For a list of the topics covered in this area see the section of this report titled "Pilot Pre-Tutorial Period". Also included in this was the assigning of students to tutors, discussion of each student's strengths and weaknesses in mathematics and interpretation of their test scores. Discussion of the format required for lesson plans, evaluation and practice in tutoring also took place.

This segment of the first quarter seemed to be very well received, primarily because it introduced the high school students to ideas and activities that were new and exciting to them and they saw practical uses for this information not only in their tutoring situation but also in the considerable part of their lives they had spent as a student/learner.

III. Spring 1981 - Second Quarter

The second quarter of the semester extended from March 30, 1981 through June 4, 1981. During this period, approximate divisions of time were (for the high school students):

50% actual tutoring,
15% discussion and preparation for tutoring,
30% on computers and
5% adminstration and testing.

Tutoring took place on an alternating day schedule. Transportation took approximately ten minutes each way and each tutoring session was thirty minutes long. Starting about two and a half weeks into the quarter, computers were received and added to the tutoring, each elementary student had about thirty minutes of comuter tutoring time for each two weeks or approxiamtely two hours for the length of the tutoring period.

Discussion and preparation for tutoring included scheduling of computer use in the tutoring sessions, working on procedures for use of the machines at the elementary schools, storage, assembling and dismantling, writing of lesson plans, gathering materials for tuitoring and time to review available software in order to see if it was suitable to be used in tutoring.

Specific topics covered in the second quarter were:

1. Review of information on computer parts and organization: nothing new was added in the second qarter with the exception of introducing the graphics tablet during the last two weeks of the quarter.

2. Programming: information on programming from the first quarter was reviewed and students were given the opportunity to practice, rather than watch, programming. Also added to their repertoire were subroutines, GOSUB - RETURN, GOTO, differences between Applesoft and Integer BASIC, initializing diskettes, nested loops, do's and don'ts of working with diskettes, string variables, generating random numbers, use of graphics tablet and debugging of programs. Students were responsible for producing a program that they could use with the person they were tutoring which included at least one subroutine, a graphics segment and was applicable to the material were teaching.

3. Social impact and applications were not discussed in class during the second quarter. This area was dealt with primarily through an assigned research paper. The topics included computer crime, computers in education, computers in business, the development of the computer, computers and the future, etc.

IV. Project Director's Overall Reactions

The results of the project so far have yet to be totally understood. As with all dealings with humans, they may not be known for a long time, if ever. However, there are some obvious indicators that success has been achieved in some areas. First, with some of the high school students it has spurred interest in computers and also generated a level of responsibility that is remarkable. Two high school students have registered for a three semester hour course in computers in the area Boulder Valley Vocational-Technical Center. Numerous other students have requested permission to either take the project course over or take a continuation of the course. Neither option, unfortunately, is presently possible. Two or three male students who had been unusually uncooperative in other courses at the high school or had done marginal work spent many hours after school either working on their assigned programs or working with available software. The project staff are currently collecting specific

attendance data to see if there was improved attendance. Many of the high school students showed a very high level of responsibility and maturity in the tutoring situation. Most developed good rapport with the elementary students. The high school students' absences were lower on tutoring days than on non-tutoring days. On three occassions, high school students showed up at the elementary school to tutor on days they had missed all other classes at the high school. As one student commented, "I just couldn't let XX down."

The teachers of the elementary students were unanimous in their comments about the students liking the attention given them by the high school tutors. Some elementary students looked forward to "tutoring days" on non-tutoring days and were very eager to get to work once the tutors arrived. Other students, not in the tutoring program, seemed to desire similar attention.

Test results on math achievement gains and the results of a mailed questionnaire to parents are presented in separate sections of this report. For the experimental phase there are certain aspects of the project that need to be dealt with. Some of these are topics that should be incorporated into the instruction and this will be easily accomodated since there will be twice the amount of class time. These topics include word processing, problem solving with computers, applications in technology, business, education and science and mathematics. Other areas of concern are ones which are beyond the realm of instruction. These include pre and post-testing on attitudes and factual information. Procedures for generating more computer time for the elementary students must be worked out. In addition the preparations for pre and post-testing of the elementary students by the project staff must be made so that we do not have to rely on the testing schedule of the school district. Lastly, I think that this project is sound and could benefit many students on both the secondary and elementary levels and think that the identification of ways to incorporate this program into the regular offerings of the district and/or exported to other districts is an important goal for the project for the coming year.

Paul Canny, Project Director

PROJECT STAFF

The staff for the project consists of the following three persons.

The Principal Investigator (PI), Dr. Marc Swadener, School of Education, Campus Box 249, University of Colorado, Boulder, Colorado 80309: Dr. Swadener has overall responsibility for the project, monitoring the collection of data, analyses of the data, keeping all records and finances, ordering of all materials and equipment, interpretation of results and writing of reports. Dr. Swadener is formally one-fifth time on the project.

The Project Director (PD), Mr. Paul Canny, St. Vrain Schools, 395 S. Pratt Parkway, Longmont, Colorado 80501: Mr. Canny's responsibilites include the teaching of the classes associated with the project both at the high school and the elementary schools, making the day to day arrangements for the project in the St. Vrain Schools and communicating with the building principals for the schools in which the project operates. Mr. Canny is the person who is on the firing line daily with respect to project activities. Mr. Canny was a regular elementary teacher with the St. Vrian Schools prior to being assigned to the project and is assigned to the project one-half time. The remainder of his time is spent in his original position as an elementary sixth grade teacher at the Main Street School, Longmont, Colorado.

A Research Assistant (RA) is also part of the project staff. This person is responsible for the actual collection of data, location of materials, computer analyses of data, and general assistance to the project director and the principal investigator. This is a half-time position and the person appointed to the position is a doctoral candidate in the School of Education, University of Colorado - Boulder. The person in this position for the 1980-81 year was James Podolak who has since completed his degree and is now Director of Research for the Colorado Board of Community Colleges, Denver, Colorado. The RA for the 1981-82 year is Mr. William Blubaugh, a doctoral candidate in Instruction and Curriculum in the Content Areas - Mathematics Education. Mr. Blubaugh came to Colorado from the Columbus, Ohio area where he was a mathematics teacher for ten years.

CONCLUSION

The evolution of the project has been rewarding and encouraging, yet at times frustrating. The potential for long term impact on the motivation and achievement of students by activities directly related to the project are great. Several conclusions can be made on the basis of the first year of the project.

1. The goals of the pilot phase of the project have been achieved. The project staff have demonstrated the feasability of carrying out the purposes of the project using the procedures and arrangements developed in the pilot phase. We are confident that the the experimental phase, using a structure similar to that of the pilot, will be a reasonable test of the original purposes of the project.

2. Given the purposes of a pilot, the difficulties encountered and the fact that some of the data from the pilot phase is incomplete, we are encouraged by the results obtained to date. We are also optomistic that additional data from the pilot phase will add to that encouragement.

3. With the hope that major inhibiting factors have been accounted for, we are anticipating significant positive change with respect to achievement, attitude and enrollment in the experimental phase. The only reservation we have at this point has just recently surfaced. This stems from a problem that may be greater than any mentioned previously. This problem is the transiency of the students at the high school. In the first two and one-half months of the experimental phase we have lost nearly seven of the initial thirty-four high school participants. If this "experimental mortality" continues at this rate we may soon have insufficient participants with which to proceed. We are monitoring this situation closely and understand that this is a common problem at the high school. It should be mentioned that these are students who have transfered from the high school or dropped from school altogether, not just dropped the project class. This problem may also stem from the inability to adhere to our original selection criteria.

4. We are encouraged by the widespread use of project equipment for the training of teachers in the use microcomputers. This outcome is above and beyond any that were specified in the original grant proposal. As was said before, this will likely have a greater impact on schools and education than the project itself.

Marc Swadener
Principal Investigator
School Of Education
University of Colorado
Boulder, Colorado

REFERENCES

1. Nie, Norman H., et. al., STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES, Second Edition, McGraw Hill, New York, 1975.

APPENDICES

A. Instruments

B. Permission Forms

C. Letters

D. Resource Materials

   1. Books

   2. Periodicals

   3. Films/Filmstrips

   4. Software

E. News Clippings

F. Certificate of Completion

G. Summary Report of the First Year for General Release

APPENDIX A
** PARENT QUESTIONNAIRE **

June 23,1981

Dear Parents,

The enclosed certificate is in recognition of your son's or daughter's participation in the computer education and tutoring project at Skyline High School, Columbine Elementary School and Spangler Elementary School. We also wish to thank you, the parent, for granting permission for your daughter or son to be a participant.

In order for us to evaluate the program this year and improve it for the next year, we would appreciate it if you would take a few minutes of your time to answer the questions below and mail this sheet in the enclosed envelope. Thank you for your support and your helpfulness.

Paul Canny
Skyline High School

Marc Swadener
University of Colorado-Boulder

==========

Please underline or circle the answer you choose.

1. What have you noticed about your son's or daughter's interest in math since participating in the project?

   a. Increased interest b. No change c. Less interest

2. In considering math skills, the project;

   a. improved the skills greatly,
   b. improved the skills some or
   c. did not change the level of skills.

3. In considering the use of time in the project, the amount of computer time was;

   a. too much, b. about right or c. not enough.

4. Would your daughter or son participate in a computer program again if given an opportunity?

   a. Yes b. No c. Uncertain

5. What was your son's or daughter's reaction to the project?

   a. Positive b. Negative c. Uncertain

6. If you have any comments about the program, please feel free to make them below or on the other side of this sheet.

APPENDIX A (cont.)

*** ATTITUDE SCALE ***

Fill in: GRADE..... AGE..... MALE..... FEMALE..... DATE.....

Read the statements below. Decide whether you strongly agree-(SA), agree-(A), are undecided-(U), disagree-(D) or strongly disagree (SD).

Circle the correct letter(s).

1.	I have never liked arithmetic.	SA	A	U	D	SD
2.	Sometimes I enjoy the challenge presented by an arithmetic problem.	SA	A	U	D	SD
3.	I have always been afraid of arithmetic.	SA	A	U	D	SD
4.	Arithmetic is very interesting.	SA	A	U	D	SD
5.	I avoid arithmetic because I am not very good with figures.	SA	A	U	D	SD
6.	I think about arithmetic problems outside of school and like to work them out.	SA	A	U	D	SD
7.	I don't feel sure of myself in arithemetic.	SA	A	U	D	SD
8.	Sometimes I feel that arithmetic is valuable for my future.	SA	A	U	D	SD
9.	I never get tired of working with numbers.	SA	A	U	D	SD
10.	Arithmetic thrills me, and I like it better than any other subject.	SA	A	U	D	SD
11.	I like arithmetic because it is practical.	SA	A	U	D	SD

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Directions: Writing only on the answer sheet provided, darken the column using the following code.

A - if you strongly disagree

B - if you disagree

C - if you are undecided

D - if you agree

E - if you strongly agree

1. I enjoy designing and building things.
2. I spend more time working with the computer than it is worth.
3. I enjoy using the computer.
4. You can get along perfectly well in everyday life without mathematics.
5. I feel using the computer is a waste of time.
6. Mathematics makes me feel as though I'm lost in a jungle of numbers and can't find my way out.
7. I am excited about the role technology will take into my future.
8. I feel at easy in mathematics, and I like it very much.
9. I like to use or would like to use a compass that shows direction.
10. The computer makes me think too much.
11. I feel that science and technology have caused many of our problems.
12. I feel as if the computer is another teacher.
13. I am very much afraid of science and technology.
14. Mathematics is easy for me.
15. I would rather do just about anything than mathematics.
16. I would enjoy fixing something mechanical.
17. Mathematics classes are usually boring.
18. I am very happy when my computer program "works".
19. Using computers is more for males than for females.
20. I feel that science and technology change things too fast.
21. I like to use or would like to use a scale to weigh things.
22. I am happier in a mathematics class than in any other class.

Code For Response:

A - if you strongly disagree

B - if you disagree

C - if you are undecided

D - if you agree

E - if you strongly agree

23. I feel confident about my ability to use computers.
24. My mind goes blank, and I am unable to think clearly when working math.
25. I like to use or would like to use a thermometer to measure temperature.
26. Mathematics is easier for me than it is for most people.
27. Mathematics is fascinating and fun.
28. More females than males have the ability to become computer specialists.
29. For the most part, science and technology will eventually solve many problems such as pollution, disease, drug abuse and crime.
30. I would rather be given the right answer to a mathematics problem than to work it out myself.
31. I often think, "I can't do it," when a mathematics problem seems hard.
32. I feel helpless around a computer.
33. Computers are a tool just like a hammer or lathe.
34. Mathematics is more of a game than it is hard work.
35. The education and training needed to prepare me to work in a technological field would be worthwhile, even if I didn't go into a related field.
36. I would stay after school almost every night to work with the computer if I could.
37. In general, females can do just as well asmales in computer careers.
38. Working with the computer in this class has increased my desire to learn.
39. The education and training needed to prepare me to work in a technological field would be worth it in the long run.
40. I feel like screaming when I have to write a program more than once.
41. Mathematics doesn't excite or fascinate me.
42. I would hate to be moved to another mathematics class where the computer was not used.
43. I am no good in mathematics.
44. Mathematics is a course in school which I have always enjoyed studing.
45. I would like a job that doesn't use any mathematics.
46. Computerization is extremely important.
47. Mathematics class time flies by when we're using the computer.

Code For Response:

A - if you strongly disagree

B - if you disagree

C - if you are undecided

D - if you agree

E - if you strongly agree

48. I feel that science and technology have changed life for the worse.
49. Computers are gaining too much control over people's lives.
50. I have never liked math, and it is my most dreaded subject.
51. It is important to me to understand the work I do in mathematics.
52. It is my guess that I an not the kind of person who works well with computers.
53. I am very satisfied with scientific and technological accomplishments.
54. I like the easy mathematics problems best.
55. I am easily frustrated when doing mathematics problems.
56. I feel that the degree of control that society has over science and technology should be increased.
57. I liked mathematics better before I began using the computer.
58. I would like to do some outside reading in mathematics.
59. Mathematics is of great importance to a country's development.
60. Writing computer programs makes me very nervous.
61. I feel satisfied with what I learn using the computer.
62. I feel tense when someone talks to me about mathematics.
63. I like to use or would like to use a calculator.
64. I feel the teacher helps me more in the computer mathematics class than teachers in other classes do.
65. Working with the computer is too confusing.
66. Computers are best suited for doing repetitive, monotonous tasks.
67. When I am in a mathematics class I am afraid to ask questions about things I do not understand.
68. Solving a difficult math problem is exciting.
69. I have a good feeling toward mathematics.
70. I don't do very well in mathematics.
71. Computers will create as many jobs as they eliminate.
72. I would enjoy fixing something electrical.
73. I like to use or would like to use a meter stick for measuring.

Code For Response:

A - if you strongly disagree
B - if you disagree
C - if you are undecided
D - if you agree
E - if you strongly agree

74. I would like to spend less time in school doing mathematics.
75. If I don't see how to work a mathematics problem right away, I never get it.
76. I enjoy using computers in my classes.
77. I enjoy doing the assignments for my computer mathematics course.
78. When I an in a mathematics class I am never afraid to ask questions.
79. Most people should study some mathematics.
80. I would enjoy working in a technological laboratory.
81. The education andtraining needed to prepare me to work in a technological field would open many job opportunities for me.
82. I work more with other students when we're working with computers.
83. I would very much like to have my own computer.
84. I haven't learned any more mathematics by using the computer.
85. I like to use or would like to use a micro computer.
86. I would like to know more about jobs in technology and engineering.
87. I feel pleased when I complete a program.
88. A person today cannot escape the influence of computers.
89. Computers dehumanize society by treating everyone as a number.
90. The education and training need to prepare me to work in a technological field cost too much.

SAINT VRAIN VALLEY PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE-1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

UNIVERSITY OF COLORADO, BOULDER
School of Education
Campus Box 249 • Boulder, CO 80309

December 1, 1980

Dear Parent/Guardian:

Your child is invited to participate in an experimental program entitled "Personal Computers and Cross-Age Instruction." The project is being directed by Mr. Paul Canny of the St. Vrain Valley Schools in association with Dr. Marc Swadener of the University of Colorado-Boulder and the Board of Education, St. Vrain Schools. The experiment involves the use of microcomputers as a tool to motivate greater interest in mathematics and science for able tenth and eleventh grade students. These high school students will spend considerable time becoming proficient in using the microcomputer and will examine the difficulties sixth graders have with mathematics. After this period the tenth and eleventh graders will tutor on a one-to-one basis, using the microcomputer as a tool, a group of sixth graders who for various reasons have diffiuculty with mathematical skills and concepts.

The aim of the project is to increase the mathematics achievement of the sixth graders, encourage a more positive attitude about their abilities in mathematics, encourage the interest in mathematics and science for the tenth and eleventh graders, and assess the effectiveness of using the microcomputer as a tool for achieving these goals.

If your child is interested in this project, and if you approve of his/her involvement please fill out the attached form and have the student return it to his/her math teacher on December 3, 1980. If you have any question concerning the project you may contact Mr. Canny at 776-5722 or Dr. Swadener at 492-7739 at the School of Education at the University of Colorado.

All students who express interest in participating in the program will be considered. Thirty students will then be selected and informed of their acceptance by Friday, December 5.

You should be aware that you may withdraw your consent at any time and at that time your child will no longer be a participant. There is no risk to you or your child in being involved in the proejct since the purpose is to aid in their understanding and achievement in mathematics, and no discredit involved in withdrawing should you feel that is necessary.

Your child will be identified by name only for the purposes of the internal procedures of the project. No reference to individuals will be made in any reports required in this project.

Questions concerning your rights as a subject can be directed to the Human Research Committee at the Graduate School of the University of Colorado and upon request you may receive a copy of this Institution's General Assurance from the Human Research Committee Secretary, Graduate School, University of Colorado, Boulder, Colorado 80309.

Appendix B (cont.)

I _____ am interested in being a participant in the Project "Personal Computers and Cross-Age Instruction." If selected I will be part of the program for the second semester of the 1980/1981 school year.

_____
(Student's signature)

I as parent or guardian of the student named give permission for _____ grade _____ to participate in the "Personal Computers and Cross-Age Instruction" program.
(Name)

_____ _____
(Parent/Guardian's signature) (Date)

_____
(Administrative Approval)

SAINT VRAIN VALLEY PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE-1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

UNIVERSITY OF COLORADO, BOULDER
School of Education
Campus Box 249 • Boulder, CO 80309

March 9, 1981

Dear Parent/Guardian:

Your child is invited to participate in an experimental program entitled "Personal Computers and Cross-Aged Instruction." The project is being directed by Mr. Paul Canny of the St. Vrain Schools in association with Dr. Marc Swadener of the School of Education, University of Colorado-Boulder and the Board of Education, St. Vrain Schools.

The program involves tenth and eleventh grade students from Skyline High School who will tutor a group of sixth grade students, who for various reasons have difficulty with mathematical skills and concepts. The tenth and eleventh grade students will spend considerable time in becoming aware of the difficulties which sixth grade students frequently have with mathematics. The high school students will be trained prior to your child's involvement.

The aim of the project is to increase the mathematics achievement of the sixth grade students; to encourage a more positive attitude about their abilities in mathematics; to encourage interest in mathematics and science for the high school students, and; to assess the effectiveness of using personal computers as a tool for achieving these goals.

If you are interested in having this type of tutoring for your child and if you approve of his/her involvement in the program, please fill out the attached form and have the child return the form to his/her teacher by March 16, 1981. If you have any questions concerning the project you may contact Mr. Canny at 772-0832 or 651-0123 or Dr. Swadener at the School of Education, University of Colorado-Boulder, phone 492-7739.

You should be aware that you may withdraw your consent at any time and at that time your child will no longer be a participant in the program. There is no risk to you or to your child in being involved in this project since the purpose is to aid their understanding and achievement in mathematics. No discredit will be involved in withdrawing your child should you feel that is necessary.

Your child will be identified by name in the project only for the purposes of the internal procedures of the project. No reference to individuals will be made in any reports required in this project.

Questions concerning your child's rights as a subject in this project can be directed to the Human Research Committee of the Graduate School, Univeristy of Colorado-Boulder. Upon request you may receive a copy of the University's General Assurance on Human Research from the Human Research Committee Secretary, Graduate School, University of Colorado, Boulder, Colorado 80309.

STUDENT'S NAME _____

I, as parent or guardian of the above named student, give my permission for his/her to participate in the program of tutoring titled "Personal Computers and Cross-Aged Instruction."

_____ _____ _____ _____

(Signature of parent/guardian) (Date) (Administrator's approval) (Date)

(Traduccion en Espanol en el reverso.)

SAINT VRAIN VALLEY PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE-1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

UNIVERSITY OF COLORADO, BOULDER
School of Education
Campus Box 249 • Boulder, CO 80309

9 Marzo 1981

Estimados Padres:

Sus hijos estan invitados a participar en un programa entitulado "Personal Computers and Cross-Aged Instuction." El projecto es dirigido por el Senor Paul Canny del Distrito Escolar del Valle St. Vrain en azosacion con el Doctor Marc Swadener de la Universidad del Colorado en Boulder y el Borde de Educatcion, Escuelas del St. Vrain.

El experimiento invuelve a los estudiantes del diez y once grados, quienes trabajaron con estudiantes del grado seis, que por alguna rason tienen difficultad con conceptos en la matematicas. Los estudiantes del diez y once pasaran bastante tiempo o buscando las dificultades que estos ninos tienen en matematicas. Los estudiantes del diez y once aprenderan varios metodos para con los estudiante del grado seis e incluyeron el usa del varias maquinas, como el claculador y computadoras para que aprendan los ninos.

La meta de este projecto es de desarollar los conceptos en matematicas del los estudiantes del grado seis, dar mas animo y una atitud positiva en las abilidades en matematicas, dor animo e interes en las ciencis y matematicas a los estudiantes del grado diez y once, y evaluar si es efectivo el uso de micro-computatores como un metodo en ensenar estos conceptos.

Si esta interesado en que sus hijos particpi en en este programa y aprueba, favor de llenar la forma que acompana esta carta y favor dedevolverla al maestro(a) antes del 1 Marzo 1981. Tambien si tiene preguntas sobre el programa puede llamar al Sr. Canny al telefono 772-0832 o 651-0123 al Dr. Swadener en 492-7739 en la Escuela de Education en la Universidad de Colorado-Boulder.

Estamos de acuerdo que puede sacar a su hijo(a) cualquier tiempo que usted quiera. No hay niguna perdida de que su hijo(a) participe en este programa, porque el programa esta designado para aumentar la sabinduria de los estudiantes en las matematicas y no seratada malo si decide sacar al estudiante del programa una ves que este dentro de este.

El estudiante sera identificado por el nombre nada mas, y niguna referencia se hara cuando los reportes se escriban.

Preguntas tocanta sus derechos como participante pueden ser dirgidos al comite "Human Research Committee" de la Escuela de Maestria (Graduate School), Universidad de Colorado. Cuando quiera puede recibir una copia de seguro General del esta Institucion del Human Research Committee Secretary, Graduate School, University of Colorado, Boulder, Colorado 80309.

NOMBRE de ESTUDIANTE ----------

Yo, como padre del estudiante nombrado arriba doy permiso pare que el participe en el programa "Personal Computers and Cross-Aged Instruction" describido el la carta que acompana esta forma.

---------- ---------- ---------- ----------

(Padres) (fecha) (Authorizacion administratriva) (fecha)

(This form is in English on the reverse side.)

SAINT VRAIN VALLEY PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE-1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

UNIVERSITY OF COLORADO, BOULDER
School of Education
Campus Box 249 • Boulder, CO 80309

Dear Parent/Guardian: August, 1981

Your child is invited to participate in an experimental program entitled "Personal Computers and Cross-Age Instruction." The project is being directed by Mr. Paul Canny of the St. Vrain Schools in association with Dr. Marc Swadener of the School Of Education, University of Colorado-Boulder and the Board of Education of the St. Vrain Schools. Major funding for the project is through a grant to the University of Colorado from The National Science Foundation. The experiment involves the use of microcomputers as a tool to motivate greater interest in mathematics and science for able tenth and eleventh grade students. These high school studetns will spend considerable time becoming proficient in using the microcomputer and will examine the difficulties sixth graders have with mathematics. After this period the tenth and eleventh grade students will tutor on a one-to-one basis sixth graders, who for various reasons have difficulty with mathematical skills and concepts. Microcomputers will be used as a tool in the tutoring situation.

The goals of the project are to increase the mathematics achievement of the sixth grade students, encourage a more positive attitude about their abilities in mathematics, encourage interest in mathematics and science for the tenth and eleventh grade students and assess the effectiveness of using the microcomputer as a tool in achieving these goals.

If your child is interested in this project, and if you approve of his/her involvement, please fill out the attached form and have your child return the form to his/her mathematics teacher on August 28, 1981. If you have any questions concerning any aspect of the project you should feel free to contact Mr. Canny at 776-5722 or Dr. Swadener at 492-7739 or 492-8742 at the University of Colorado.

All students who express interest in participating in the program will be considered. However only thirty students will be selected. Students who are selected will e notified of their acceptance by September 1, 1981.

You should be aware that you may withdraw consent for your child's participation at any time, without any discredit to your child. At that time your child will no longer be a participant in the project. There is no risk to your child in being involved in the project since it's purpose is to aid their understanding and interest in mathematics and science.

Your child will be identified by name within the project only for the internal procedures of the project. No reference to individual student participants will be made in any reports resulting from this project.

Questions concerning your childs rights as a subject in this study can be directed to the Human Research Committee of the Graduate School of the University of Colorado and upon request you may receive a copy of the University's General Assurance from the Human Research Secretary, Graduate School, University of Colorado, Boulder, Colorado 80309.

I (name) _____ am interested in being a participant in The project "Personal Computers and Cross Age Instruction." If selected I will be part of the program for the 1981-1982 school year.

(Student's signature) _____ (Grade) _____

I, as parent/guardian, give my permission for the above named student to participate in the "personal Computers and Cross-Age Instruction" project for the 1981-1982 school year.

_____ _____
(Parent/guardian signature) (Date)

_____ _____
(Administrator's approval) (Date)

Appendix C

RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES
INVOLVING HUMAN SUBJECTS

TO: Human Research Committee

FROM: Marc Swadener School of Education (Department) x7739 (ext.)

PROJECT TITLE: Personal Computers and Cross-Age Instruction

(NSF-Developements in Science Education Program)

1. Project description as it relates to human beings. Include the questions to be asked, methods to be used, and subject population to be studied with its method and recruitment in sufficient detail for the Committee to assess the potential hazards. Please do not quote from your protocol and keep in mind that members of the Committee do not have special knowledge of your field. If additional space is required, attach sheet.

This project will develop a combinational strategy of personal computers and cross-age instruction in order to:

1) Increase the level of basic math skill of low-achieving, sixth grade students;
2) Increase the number of students enrolling in high school math and science courses;
3) Evaluate microcomputers as unique instructional tools;
4) Develop effective applications of microcomputers in education.

The development plan includes identifying 60 low-achieving sixth grade students and 60 non-math/science oriented, able tenth grade students. (Half of each group will serve as control groups.) During the first semester, 30 tenth graders will study specific areas of math weakness of 30 sixth graders and will develop microcomputer courseware for them. Each tenth grader will work one-to-one with sixth graders during the second semester, implementing and further developing courseware.

The anticipated results of the project include an increase in students' math and problem-solving skills, as well as increased enrollment in math and science classes beyond grade ten.

2. Your assessment of the risks and potential benefits of the investigation. If additional space is required, attach sheet. For your information, the DHEW definition of risk follows. "Subject at risk means any individual who may be exposed to the possibility of injury, including physical,

Appendix C (cont.)

psychological, or social injury, as a consequence of participation as a subject in any research, development, or related activity which departs from the application of those established and accepted methods necessary to meet his needs, or which increases the ordinary risks of daily life, including the recognized risks inherent in a chosen occupation or field of service."

The only risk that is anticipated in this project is the possiblity that those students not in the experimental groups may not achieve as greatly as those in the experimental groups. There is absolutely no physical or psychological risk for those students who are in the experimental group. These experimental group students will be selected on several bases: their past record in school, teacher recommendation and parent/guardian recommendation. All such subjects will be volunteers and have the full approval of parent/guardian. This project has the complete approval and endorsement of the Board of Education, St. Vrain Schools in which the project will take place.

3. Are investigational drugs to be used? ___Yes _X_No (If yes, list generic name of the drug _____.)

4. If research is supported by grant funds, please give grant number _____.
NSF Developments in Science Education proposal. (C Proposal # C479.5.29DB

5. ATTACH CONSENT FORM. Regardless of risk or burden imposed by participation, the following points must be included:
(1) A fair explanation of the procedures to be followed, and their purposes, including identification of any procedures which are experimental;
(2) a description of any attendant discomforts and risks reasonably to be expected;
(3) a description of any benefits reasonably to be expected;
(4) a disclosure of any appropriate alternative procedures that might be advantageous for the subject;
(5) an offer to answer any inquiries concerning the procedures;
(6) an instruction that the person is free to withdraw his consent and to discontinue participation in the project or activity at any time without prejudice to the subject; and
(7) an instruction that questions concerning rights as a subject be directed toward the Human Research Committee and an offer to provide a copy of this Institution's General Assurance which is available from the committee secretary, The Graduate School, University of Colorado, Boulder 80309.

You are reminded that informed consent forms are privileged institutional records and must be protected for confidentiality of information on individual subjects.

Wade Swadener
Signature of Principal Investigator

4/25/79
Date

Appendix C (cont.)

CONSENT FORM

Your child is invited to participate in an experimental program entitled "Personal Computers and Cross-Age Instruction." The project is being directed by Ms. Kathleen Gilbert in association with Dr. Marc Swadener of the University of Colorado-Boulder and the Board of Education, St. Vrain Schools. The experiment involves the use of microcomputers as a tool to motivate greater interest in mathematics and science for able tenth graders. These tenth graders will spend considerable time becoming proficient in using the microcomputer and will examine the difficulties some sixth graders have with mathematics. After this period the tenth graders will tutor on a one-to-one basis, using the microcomputer as a tool, a group of sixth graders who for various reasons have difficulty with mathematical skills and concepts.

The aim of the project is to increase the mathematics achievement of the sixth graders, encourage a more positive attitude about their abilities in mathematics, encourage the interest in mathematics and science for the tenth graders, and assess the viability of using the microcomputer as a tool for achieving these goals.

If your child is interested in this, and if you approve of his/her involvement in this project and if you have questions concerning the project you may contact either of the two above named persons by calling 492-7739, at the School of Education, University of Colorado-Boulder.

You should be aware that you may withdraw your consent at any time and at that time your child will be returned to the regular school program. There is no risk to you or your child in being involved in the project since the purpose is to aid in their understanding and achievement in mathematics, and no risk involved in withdrawing should you feel this is necessary.

Your child will be identified by name only for the purposes of the internal procedures of the project. No reference to individuals will be made in any reports required in this project.

Questions concerning your rights as a subject can be directed to the Human Research Committee at the Graduate School of the University of Colorado and upon request you may receive a copy of this Institution's General Assurance from the Human Research Committee Secretary, Graduate School University of Colorado, Boulder, Colorado, 80309.

I understand the above information and give my voluntary consent for the participation of the below named student in the experiment entitled: "Personal Computers and Cross-Age Instruction."

Name of Student	Signature of Parent or Guardian	Date

UNIVERSITY OF COLORADO
BOULDER, COLORADO 80309

OFFICE OF THE DEAN
GRADUATE SCHOOL
CAMPUS BOX B-26

June 11, 1980

Professor Marc Swadener
School of Education
Campus Box 249

Dear Professor Swadener:

Your research project entitled, "Personal Computers and Cross-Age Instruction," was reviewed by the Human Research Committee of the Boulder Campus at its meeting of June 10, 1980. I am happy to report that we approved your project with respect to risk to the human subjects in your research.

The Committee thanks you for your concern for the welfare of human subjects and hopes that your investigations will be successful.

Sincerely,

Joyce Nielsen

Joyce M. Nielsen
Chair
Human Research Committee, Boulder

JMN:cn

Appendix C (cont.)

UNIVERSITY OF COLORADO
Office of the Vice Chancellor for Research and
Dean of the Graduate School
Boulder, Colorado 80309

June 11, 1979

Professor Marc Swadener
School of Education
Box 249
Boulder Campus

Dear Professor Swadener::

Your research project entitled, "Personal Computers and Cross-Age Instruction," was reviewed by the Human Research Committee of the Boulder Campus at its meeting of June 8, 1979. I am happy to report that we approved your project with respect to risk to the human subjects in your research. The necessary certification forms have been completed and forwarded to NSF.

The Committee thanks you for your concern for the welfare of human subjects and hopes that your investigations will be successful.

Sincerely,

Gary McClelland
Chair
Human Research Committee, Boulder

GM:cd

SAINT VRAIN
VALLEY
PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE 1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

Dr. F. Keith Blue
Superintendent of Schools

September 23, 1980

Dr. Marc Swadener
School of Education
University of Colorado
Boulder, CO 80309

Dear Marc,

The NSF grant proposal was directed to our Superintendent of Schools, Dr. Keith Blue, and we are preparing to present it to the Board of Education as a report at the first Board of Education meeting in October.

However, it was felt that a memo of understanding from you would help facilitate the process. Would you please, therefore, send a letter indicating the general statements contained in the proposal regarding who is responsible for the different procedures contained in the proposal, what the purpose of the proposal is, any dates that you feel to be important to the development of the proposal, and so on.

At the time of receipt of your letter the Department of Instruction will draft a letter, indicating our agreement to the memo of understanding, and this material will be presented with a copy of the proposal to the Board of Education as a report.

If you have any questions as to our needs please feel free to contact me at 776-6200 ext. 275. Thank you very much for your help.

Sincerely,

Jerry

Jerry Trowbridge
Director of Instruction

UNIVERSITY OF COLORADO, BOULDER

School of Education

September 30, 1980

Jerry Trowbridge
Director of Instruction
St. Vrain Valley Schools
395 S. Pratt Parkway
Longmont, CO 80501

Dear Mr. Trowbridge:

This letter concerns the National Science Foundation Development in Science Education grant number SED-791897. This grant to the University of Colorado from the NSF is for a project titled "Personal Computers in Cross Age Instruction" beginning September 15, 1980 and expiring February 28, 1983, the last six months of which are for final analysis of results and writing the final report.

Early in the development of the proposal for the grant I had contacted appropriate persons in St. Vrain Schools about the possibility of their involvement. This was done because St. Vrain Schools had a reasonably sophisticated conception of and taken action in instructional use of computers. At that time their interest was expressed and the proposal was forwarded to the NSF with St. Vrain Schools desire to be involved. It was recognized however that formal approval of St. Vrain's involvement would be requested when the grant was received. This is the purpose of this letter.

There is some information which might be useful to St. Vrain schools in considering this formal invitation to participate in the NSF project. I will try to cover this information below.

1. Objectives of the project: The objectives of the project are;

   a. To increase the level of basic mathematical skill of low achieving sixth grade students
   b. Increase the number of students enrolling in high school mathematics and science courses. Primarily in this case through attempting to reverse the decision of some average and above average tenth grade students who have decided to cease taking mathematics courses.

   c. Determine the feasability of using a combination of tenth grade students and microcomputers as tutors for mathematically low achieving sixth grade students.

Campus Box 249 • Boulder, CO 80309

d. Develop effective applications of microcomputers in schools.

2. Personnel involved: The personnel directly involved in the conduct of the project will be

   a. Dr. Marc Swadener, Associate Professor, School of Education, University of Colorado -Boulder who is the Principal Investigator (PI) in NSF terms. Basically this means that he is in charge of the overall conduct of the study.

   b. A person yet to be chosen by the St. Vrain Schools to be the project director (PD). This person will be a 1/2 time with the project, will be paid (including benefits) by the St. Vrain Schools but this pay will be reimbursed to St. Vrain Schools from the grant funds.

   c. A 1/2 time research assistant hired by the University and paid by the grant

3. Equipment to be purchased. All of the below named equipment will be purchased from grant funds. St. Vrain Schools will retain seven items under A and two items under B when the grant terminates. During the conduct of the grant maintenance will be paid through the grant. After the grant terminates such maintenance as will be required for the equipment retained by St. Vrain Schools will be the responsibility of St. Vrain Schools.

   A. Nine Apple II 48k mini computers with single disk drive and video display
   B. Three printers with interface for the Apple II.

   Actual ordering of equipment will be done through the University.

4. Travel with the grant: The grant has an allocation within it for travel for the Project Director (PD) and principal investigator (PI) to several professional meetings: The National Council of Teachers of Mathematics Annual meetings in 1981 and 1982, Computers in Education Conference in 1982 (PD only). The Diagnostic and Prescriptive teaching of Mathematics conference 1981 (PD) and 1982 (PI), plus one meeting per year for NSF business in Washington, D.C. Thus the PD will be away from St. Vrain Schools for meetings about 24 days during the two years of the project. Actual meeting expenses (travel, housing, meals, and fees) will be reimbursed from the grant. However there has been no allowance for paying a substitute teacher from the grant should a substitute teacher be necessary.

5. Clerical assistance for the grant is being provided by the University. This includes typing of reports, letters, ordering of equipment, etc.

6. The grant also has an allocation for computer software and supplies needed within the grant.

7. Allowable reimbursed expenses as indicated above will be reimbursed to St. Vrain schools from grant funds on deposit with the University. Specific reimbursement arrangements will be established in consultation with St. Vrain schools and representatives of the Office of Contracts and Grants of the University.

8. Overall design of the experimental portion of the project: Average and above average tenth graders will be trained in the use of the mini-computer and in the difficulties which sixth graders encounter in mathematics. These students will then tutor sixth graders with low mathematics achievement using the mini-computer as a tool.

9. Significant dates for the project - see attached timetime.

A note in addition to the above. When the grant was requested we tried to anticipate as much as possible expenses that would be incurred in the project. I believe we have done this reasonably well. It is my expectation that few incidental costs will be incurred by St. Vrain schools because of the project, aside from providing a substitute teacher for about 24 days during the two years of the grant. We will try to absorb even this substitute teacher expense from grant funds but cannot at this time commit such funds for this purpose.

Given the above information and that contained in the grant request, we formally request the approval of the administrators of St. Vrain Schools to conduct this project in the St. Vrain School District as a cooperative project with the University and the National Science Foundation.

Should you have any questions or need additional information please feel free to contact me.

Respectfully submitted,

Marc Swadener
Associate Professor

SAINT VRAIN
VALLEY
PUBLIC SCHOOLS
SCHOOL DISTRICT NO. RE-1J
395 S. PRATT PARKWAY LONGMONT, COLORADO 80501

Dr. F. Keith Blue
Superintendent of Schools

June 23, 1981

Dr. Marc Swadener
University of Colorado
236 Education Building
Campus Box 249
Boulder, CO 80309

Dear Marc:

I am sorry that we are so long in responding to your letter related to the approval by administrators of the St. Vrain Valley Schools to conduct the project in our district as a cooperative project with the University of Colorado and the National Science Foundation.

This letter will serve to do that very thing and you have our assurance that not only have the administrators of the district approved the project but the St. Vrain Valley Board of Education has also given approval for the project to operate within the district.

I appreciated your observation that there might be some tension existing between Randy Wallace and Paul Canny relative to the grant. I have met with Paul and Randy and had a productive conversation with them concerning the equipment and the grant.

While I did discover some areas of misunderstanding, I feel that very little tension actually is present in their relationship. What is there seems to be lack of definition of their respective roles relative to the grant and I have asked the gentlemen working together to detail for me a written document outlining the manner in which each would operate in respect to the grant. Randy and I recognize Paul as the primary responsible person for the grant and as such the individual who will make all basic decisions. Mr. Wallace has agreed to work as the laison with Paul answering questions and providing what help he can from the Department of Instruction.

The St. Vrain Valley School District appreciates the opportunity to work with the University of Colorado in this project and would appreciate such continued support as we have had from you. Should you have any further cause for concern, I would appreciate you letting us know so that we might respond to it.

Sincerely,

Dr. Jerry Trowbridge
Director of Instruction
(NSF grant #SED 7918974)

JT/dh

UNIVERSITY OF COLORADO
79
Graduate School
Office of the Dean

July 15, 1981

Professor Marc Swadener
School of Education
Campus Box 249

Dear Professor Swadener:

Your research project entitled, "Personal Computers and Cross-Age Computers," was reviewed by the Human Research Committee of the Boulder Campus at its meeting of July 15, 1981. I am happy to report that the Committee approved your project with respect to risk to the human subjects in your research. The necessary certification forms have been completed and forwarded to NSF.

Thank you for your concern for the welfare of human subjects. I hope that your investigations will be successful.

Sincerely,

Verne

Verne Keenan
Chair
Human Research Committee, Boulder

VK:cn

308 Regent Administrative Center • Campus Box B-26 • Boulder, Colorado 80309 • (303) 492-7401

Appendix C (cont.)

ATTACHMENT 3

UNIVERSITY OF COLORADO

CERTIFICATION FOR PROJECTS OR ACTIVITIES INVOLVING HUMAN SUBJECTS

Project Number (if known) SED79-18974

Title of Proposal Personal Computers and Cross-Age Instruction

Principal Investigator or Program Director Marc Swadener

Applicant Organization University of Colorado at Boulder

The Human Research Committee of the University of Colorado reviewed and approved on July 15, 1981 (date) the procedures in this application which will involve human subjects. This review is in accordance with the Institutional Assurance approved by the Department of Health, Education, and Welfare on February 19, 1976 (date). These procedures will be subject to continuing review under the terms of that Assurance.

Verne Keenan

Verne Keenan (name)

Associate Professor of Education
(title)

Chairman, Committee on Human Research

APPENDIX D

** RESOURCE MATERIALS

1. Books

The following books were consulted for various information related to the project.

A GUIDE TO THE DIAGNOSTIC TEACHING OF ARITHMETIC (2nd ED.) by Frederika Reisman, Charles Merrill pub. Co., Columbus OH, 1978.

A GUIDED TOUR OF COMPUTER PROGRAMMING IN BASIC by Thomas Dwyer and Michael Kaufman, Houghton Mifflin Company, Boston, MA 1980.

APPLE II REFERENCE MANUAL, Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. This book comes with the APPLE II computer when it is first purchased.

APPLE PASCAL - A HANDS ON APPROACH, McGraw - Hill, P.O. Box 400, Hightown, NJ 08520 ($14.95) Used for reference only in the project.

APPLESOFT TUTORIAL, Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. This book comes with the APPLE II computer when it is first purchased.

BASIC A FIRST COURSE by Robert Thompson, Charles Merrill Pub. Co., Columbus, OH

BASIC PROGRAMMING REFERENCE MANUAL, Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. This book comes with the APPLE II computer when it is first purchased.

COMPUTERS AND EDUCATION, by James Poirot, Sterling Swift Publishing Co., P.O. Box 188, Manchaca, TX 78652 ($6.95)

COMPUTER LITERACY SHOW AND TELL KIT, Sterling Swift Publishing Co., P.O. Box 188, Manchaca, TX 78652 ($59.95) This is a loose leaf bound, shrink packaged collection of actual computer devices to be used as exhibits in computer literacy classes. Students can actually touch the real things not just be told about them or just see pictures.

COMPUTER GRAPHICS PRIMER (#91003) from Creative Publications, P.O. Box 10328, Palo Alto, CA 94303 ($12.95).

COMPUTERS FOR KIDS (APPLE II Edition), Creative Computing, P.O. Box 789-M, Morristown, NJ 07960 ($3.95). An excellent book on computers and their operation for elementary aged children. The APPLE II edition has some pages that include TRS-80 programming code which is a bit of a problem.

1. Books (cont.)

COMPUTER PROGRAMMING IN THE BASIC LANGUAGE by Neal Golden, Harcourt, Brace and Javanovich, New York, 1971.

DIAGNOSING MATHEMATICAL DIFFICULTIES by Bob Underhill, Ed Uprichard and James Heddens, Charles Merrill Pub. Co., Columbus OH 1980.

DISK OPERATING SYSTEM INSTRUCTION AND REFERENCE MANUAL (DOS 3.3 VERSION), Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. This book comes with the APPLE II computer when it is first purchased.

EDUCATIONAL SOFTWARE DIRECTORY, APPLE II EDITION, Sterling Swift Publishing Co., P.O. Box 188, Manchaca, TX 78652 ($9.95) One source of ideas on what software is available. References include annotations and addresses of the sources.

ELEMENTARY MATHEMATICS - VOL. 1 Teacher Support Booklet, MECC, 2520 broadway Dr. St. Paul, MN 55113 ($3.20) See reference under "Software".

ERROR PATTERNS IN COMPUTATION by Ashlock, Charles Merrill Pub. Co., Columbus, OH, 1976.

GRAPHICS SOFTWARE FOR MICROCOMPUTERS, from Kern Publishers, 190 Duck Hill Rd., Duxbury, MA 02332. this is a book that deals solely with graphics and has an associated diskette (see reference under "Software"). Cost for the combination package is $42.90.

INTRODUCTION TO COMPUTERS AND COMPUTING, by Jean Rogers from ICCE, Eastern Oregon College, Legrand,OR 98150 ($2.50) This is a general introduction to computers and computing.

INTRODUCTION TO LOW RESOLUTION GRAPHICS by Nat Wadsworth, SCELBI Publications, Elmwood, CT 06110.

MATHEMATICS AROUND US by Bolster and others, Scott Foresman and Co., Glenview, IL, 1972.

MATHEMATICS FOR INDIVIDUAL ACHIEVEMENT by Richard Denholm and others, Houghton Mifflin Co., Boston, MA, 1974.

MICROCOMPUTERS AND THE 3-R'S by Christine Doerr, Hayden Book Company, Rochelle Park, NJ

MICROCOMPUTER WORKBOOK - APPLE II Edition, 2nd Edition, Sterling Swift Publishing Co., P.O. Box 188, Manchaca, Tx 78652 ($5.95) See discussion under "Software".

APPENDIX D (cont.)

1. Books (cont.)

MODERN SCHOOL MATHEMATICS by Duncan and others, Houghton Mifflin Co., Boston, MA 1972.

PEER TUTORING FOR INDIVIDUALIZED ISTRUCTION By Stewart Ehly and Stephan Larsen, Allyn and Bacon, Rockleigh, NJ 07647, 1980 ($18.70). An excellent resource on tutoring. Includes techniques and methods.

PROGRAMMING IN BASIC by David Heiserman, Prentice Hall, Inc., Englewood Cliffs, NJ 07632.

SIXTY CHALLENGING PROBLEMS WITH BASIC SOLUTIONS by Donald Spencer, Hayden Book Company, Rochelle Park, NJ

WHAT'S WHERE IN THE APPLE, from MICRO, 34 Chelmsford St., P.O. Box 6502, Chelmsford, MA 01824. ($16.95) This is a book that details what the different registers in the APPLE are used for and specifies how they can be accessed.

2. Periodicals

The following periodicals were regularly consulted for information on available software and other information that could be of use to the project.

A.P.P.L.E., 304 Main Ave. Suite 300, Rexton, VA 98055 ($15.00 membership fee + $25.00 annually) Written specifically for the APPLE user.

BYTE, P.O. Box 590, Martinsville, NJ 08836 ($34.00 annualy) A good source of information on available software, hardware and uses of computers.

CLASSROOM COMPUTER NEWS, P.O. Box 266, Cambridge, MA 02138 ($16.00 annually) A good source of information on the use of computers in instruction.

COMPUTERS IN MATHEMATICAL SCIENCES EDUCATION (CIMSE), part of the National Consortium on Uses of CIMSE, affiliated with the Association for the Development of Computer Based Instructional Systems (ADCIS), Mathematical Sciences Teaching and Learning Center, 014 Memorial Hall, University of Delaware, Newark, DE 19711.

COMPUTERWORLD, 375 Cochituate Rd., Box 880, Framingham, MA 01701 ($36.00 anually). This is a weekly newspaper on microcomputers.

CREATIVE COMPUTING, Dumont Pl., Box 789M, Morristown, NJ 07060 ($15.51 annually). A source of avaiable software and use of microcomputers.

APPENDIX D (cont.)

2. Periodicals (cont.)

EDUCATIONAL COMPUTER MAGAZINE, P.O. Box 535, Cupertino, CA 95015 ($20.00 annually). A monthly magazine of software and educational applications of computers.

INFO WORLD, 375 Cochituate Rd., Box 880, Framingham, MA 01701 ($25.00 annually) This is a weekly newspaper on microcomputers and is a good source of up to date information on software and hardware.

INTERFACE AGE, P.O. Box 1234, Cerritos, CA 90701 ($30.00 annually). A monthly magazine which contains reviews of software and articles on computers and their use.

MICROCOMPUTERS IN EDUCATION, from Queue, 5 Chapel Hill Dr., Fairfield CT 06432 ($15.00 anually). A monthly annotated catalog of software available from Queue along with short articles.

MICRO, 34 Chelmsford, P.O. Box 6502, Chelmsford, MA 01824. ($18.00 annually) A monthly magazine which contains reviews of software and articles on computers and their use.

NIBBLE, Box 325, Lincoln, MA 01713 ($17.50 annually)

PERSONAL COMPUTING, 420 Madison Ave., New York, NY 10017 ($19.95 annualy) A magazine with articles and softwre concerning personal computing.

PIPELINE, from CONDUIT, P.O. Box 388, Iowa City, IA 52244 ($15.00 annually). A magazine issued twice yearly with software available from CONDUIT and articles about instuctional applications of computers. Primarily for higher education.

POPULAR COMPUTING, P.O. Box 307, Martinsville, NH 08836 ($11.97 annually). A monthly magazine which contains reviews of software and articles on computers and their use.

THE COMPUTING TEACHER, Eastern Oregon State College, Legrand, OR 97850 ($14.50 annually). This journal is directly related to instructional uses of computers.

T.H.E. JOURNAL (TECHNOLOGICAL HORIZONS IN EDUCATION), Information Synergy, Inc., P.O. Box 992, Acton, MA 01720 ($15.00 annually). A good source of the latest information of developments in software and hardware, includes articles on use of technology in instruction.

APPENDIX D (cont.)

3. Films/Filmstrips

COMPUTER CONCEPTS, a three filmstrip series avaialble from RMI Media Productions.

DONALD IN MATHEMAGIC LAND, Walt Disney Productions, Los Angeles, CA. A delightful film about mathematics and its significance, suitable for any grade level or age. (about 30 minutes in length.)

4. Software

APPLE GAME PAK from Apple Puget Sound Proram Library Exchange (A.P.P.L.E.), 6708 39th Ave. SW, Seattle, WA 98136.

APPLESOFT TUTORIAL from Sterling Swift Publishing Co., P.O. Box 188, Manchaca, TX 78652 ($50.00) This diskette along with the associated book (see above) is an excellent interactive instructional program for operation and beginning programming commands for APPLESOFT on the APPLE II.

COMPUMATH and ALGEBRA I, diskettes for APPLE II from Edu - Ware, 2222 Sherman Way, Suite 208, Cnaoga Park, CA 91303. Each diskette costs about $40.00. The first includes most basic mathematics operations the second is strictly algebra.

ELEMENTARY MATHEMATICS - VOL. 1 from MINNESOTA EDUCATIONAL COMPUTING CONSORTIUM (MECC), 2520 Broadway Dr., St. Paul, MN 55113 ($20.00) this diskette and the associated booklet of teacher materials (and others like it) from MECC is an excellent resource.

FRACTIONS, from ETA, 159 w. Kinzie St., Chicago, IL 60610 ($75.00) This diskette has seven supprograms relating to oprations with fractions. When we first received this none of the programs would run. The company has been notified and is correcting the problem.

FRENCH MINITARY GAME by G. H. Herd in CREATIVE COMPUTING, september, 1978.

GRAPHIC SOFTWARE, (see listing under books) This diskette is a graphics tool for the APPLE. With the associated book is very useful in assisting in building graphics programs.

LEMONADE, Available from MECC (See reference for MECC under software titled ELEMENTARY MATHEMATICS above.)

MATH FUN (#4P-0160AD) from Opportunities for Learning, 8950 Lurline Ave., Dept. GE, Chatsworth, CA 91311 ($22.95) The interactions necessary within several of the programs on this diskette require mathematical skills which are somewhat more advanced than those which are the focus of the program itself.

APPENDIX D (cont.)

4. Software (cont.)

MATH SKILLS by Craig A. Mills, Softside Publications.

OTHELLO, a computized version of the game, an excellent strategy game. This version of the program was authored by Gary Shannon (address unknown) and was available through St. Vrain School district files.

PROGRAMMING IN APPLE INTEGER BASIC - SELF TEACHING SOFTWARE (#05009) from Hayden Book Co., 50 Essex St. Rochelle Park, NJ 07662 ($39.95) This is a tutorial on APPLE integer BASIC.

THREE MILE ISLAND, Muse, 330 N. Charles St., Baltimore, MD 21201 ($39.98). This is a intricate simulation of the operation of a nuclear power plant and includes the manipulation of upwards of fifty valves, pumps, filters and control rods. It includes economic decisions as well since the purpose of the exercise is to make a profit. An individual user's status in a game may be stored in order to allow restarting where one left off.

LONGMONT DAILY
TIMES-CALL
109th YEAR SINGLE COPY 15¢ LONGMONT, COLORADO (80501) (U.S.P.S. 318 880) WEDNESDAY, APRIL 25, 1979 NO. 99 40 PAGES

Computer education program

District being considered for grant

By MARILYN FRITZLER

R2-D2, C-3pO, and a legion of fellow robots. Imagine them coursing through the St. Vrain Valley, taking out your trash, doing a week's collection of dirty dishes and maybe polishing off a little of that tedious paperwork.

The picture is delightful, and one Randy Wallace, math coordinator for the St. Vrain Valley School District, is hopeful will become at least technically possible.

The district is being considered by the National Science Foundation (NSF) for a $81,900 grant to fund a computer education program designed to improve students' problem-solving and general math skills.

The NSF is in the final stages of screening grant applicants and Wallace said, "it appears very likely we will get it." Final word on the award of the grant should be received by the district from NSF in September, Wallace said.

The grant would provide for the purchase of six computers to be housed initially at Niwot High School next fall. During the 18-month program, Niwot sophomores would tutor Sixth graders from Burlington Elementary School in writing programs for computers, Wallace said. Choice of those schools was made by Kathleen Gilbert who, with Marc Swadener, a Colorado University math professor, will act as project coordinators.

There will be little cost to the district, Wallace said, other than to provide office space and files.

Eventually, the NSF-funded computers will be moved around between the district's schools, Wallace said, as is the comparable computer the district now owns. That computer, which is rotated between schools every 10 weeks, is now at Mead.

If the NSF grant is awarded to the district, students first would be screened and tested for participation in the project and the necessary computer equipment purchased, Wallace said. During the next semester, computer programs would be written and run through the computers.

Afterward, Wallace said, math and problem-solving skills of students will be assessed to see what effect the computer project has had on their abilities. The results of that study will be presented at national conferences on education, Wallace said.

The computer project is expected to improve the basic math skills of underachieving sixth graders and increase enrollment in high school math and science classes, Wallace said.

An electronics expert from Denver will help students design a "microprocessor interface with a music system, a voice synthesizer, or a small robot," Wallace said. Those three systems combined would allow students to talk to a robot through the computer, he said.

Appendix E

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87

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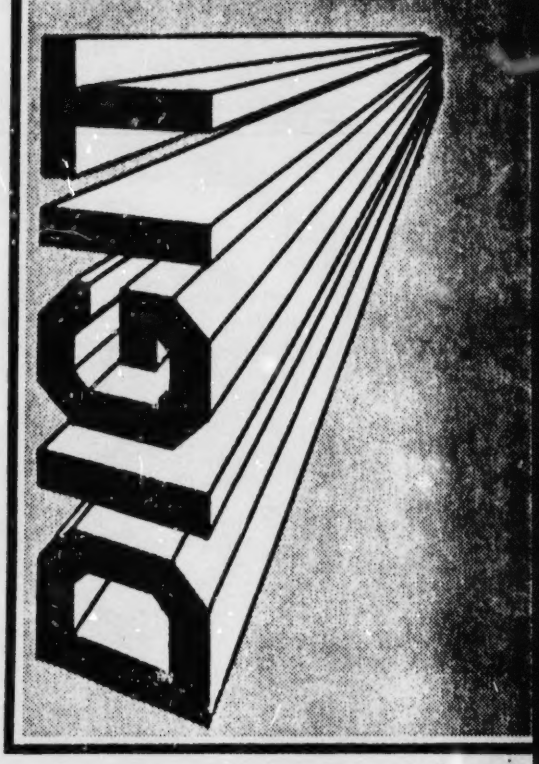
Appendix E (cont.)

University Computing Center Newsletter
Center of Excellence
February 1981
Volume 15 Number 2



USER PROFILE

The Laboratory for Research in Science and Mathematics Education, a program within the School of Education, has recently received a two-year, $85,000 grant from the National Science Foundation to establish an experimental program within the St. Vrain schools using Apple microprocessors (microcomputers). Under the direction of Marc Swadener, the project is currently in the pilot test stages with the actual implementation scheduled for the 1981-82 school year.

The two primary objectives of the project are to increase the capabilities of low achievement sixth graders who are in the project, and to increase the proportion of the high school students who continue to take mathematics and science courses. The high school students chosen will be average and above average students currently enrolled in mathematics classes which, when completed, commonly result in a decision to discontinue further mathematics classes. These high school students will spend time studying the mathematical difficulties encountered by low achieving sixth graders and in the operation and fundamental programming of the microcomputers. These students will then tutor the low achieving sixth graders on a one-to-one basis using the microcomputer when appropriate.

As a part of the program, nine Apple microprocessors are being purchased to assist in the tutoring program as interest generating and motivational devices. Although preprogrammed packages will be used initially, it is anticipated that the high school students will become proficient enough to write additional programs that can be used by the sixth graders in developing their math skills. At the end of the two-year grant, most of the Apples will be left with the St. Vrain school district as a means of fostering a continuation of the use of computers in instruction.

Appendix E (cont.)

The Skyline Sun

Skyline High School
Longmont, Colorado

Volume 3, Number 12
March 6, 1981

Computer Class at Skyline

By Marcia Austin

The National Science Foundation is sponsoring a new computer course which started second semester at Skyline High School. The foundation is part of a research project trying to see how well high school students will work as tutors for younger children.

Through the course, the students are learning how to run and program computers. They will then use the skills they have learned to tutor 6th grade students at Columbine and Spangler Elementary Schools that are having problems in math.

Mr. Paul Canny is the teacher for the computer course. Canny has only taught elementary school before and says he is really enjoying teaching in a high school situation.

Canny says his goals for the class are to help students feel more comfortable with math and with the computers, and to do a good job of tutoring the 6th graders.

Mr. Paul Canny helps student Carl Leonard with an assignment.

The computers have been ordered for the class but they haven't come in yet. In spite of this, Canny said, "I think it is working pretty well. The students seem interested in what is going on."

Sara Hugger, junior, said, "The course is interesting. I like it."

Matt Newby, sophomore, feels that the course has a lot to offer. "It is educational and prepares you for a job in computers," he said.

Leanna Kennedy, junior, feels that "more computer courses should be offered, because they prepare you for a job in the future."

After spring break, the class will begin tutoring 6th grade students. Hopefully the computers will be in by then.

Students learn with computers

By MARGE LASTICK
Times-Call Staff Writer

Stacy Alford and Dean Haakonson are trying to kill each other. And Leanne Kennedy is promoting the violence.

"Try a bigger angle with the same ammunition," she advises Alford. But the next minute, Kennedy, a Skyline High School student, has switched sides and is urging Haakonson to fire his shell at a shorter angle with a little extra power.

Intent on destroying each other, the foes — both sixth graders at Spangler Elementary School — eagerly take their mentor's advice. "I know exactly what I have to do," says Haakonson with an evil gleam in his eye.

As the assailant's shell manages to overcome a strong wind, makes it over the mountain and appears to be right on target, he clenches his fists and whispers, "go, go." Meanwhile, Alford, the obviously frightened would-be victim cries,"You'd better miss me."

Kennedy, not sure where her loyalty lies, seems half-relieved, half-disappointed when the shot falls inches short of its mark. All players clearly are caught up in the battle, being played on the screen of an Apple II computer.

The idea of the simulations is to motivate students in developing strategies to solve mathematical problems, according to teacher Paul Canny. Canny, who teaches mornings at Loma Linda Annex Elementary, has been teaching an afternoon computer class at Skyline since January.

A National Science Foundation grant, awarded to the St. Vrain Valley School District last spring, paid for that position and for nine new Apple II units. Four still are at Skyline where 27 sophomores and juniors have learned to use a variety of software programs and now are beginning to write their own.

Under a pilot tutorial program, the other five are at Spangler and Columbine elementary schools. Every other day for the past month, the high school experts have been visiting the two schools to teach sixth graders how to use computers.

Each is paired with an individual who has been having trouble in math, according to Canny. Not all get to use the machines every day, and the high school students act as traditional tutors the rest of the time.

The tutoring part obviously isn't as much fun. One sad-looking boy is completing a dry lesson on fractions and decimals while listening to others scream in the background: "This machine is a rip-off, it always misses" and "Wait till next time, you're going to die." "At least, I get the computer on Monday," he says.

"We're here to help them with whatever they're doing," said tutor Janice Householder. Sometimes, she said, it is frustrating, "but now we know how teachers feel."

And the computers are more than just fun. Haakonson said he certainly has learned his angles from the artillery game, one of the most popular of 50 or so different programs. While the simulations don't necessarily correspond to specific classroom lessons, Canny said all tie in with math in general.

"They learn how to solve problems, to work out strategies for winning and learning," he said. Canny added that the computers aren't intended to replace or duplicate paper-and-pencil drills. He said the machines teach some of the same things and more.

A lemonade stand program, for example, involves many variables such as time of day and weather conditions, he said. "They have to consider everything if they want to make any money. The whole idea is to put new excitement into learning for kids who have been used to failure."

Canny said the 1 1/2-year research project will be expanded next year and participating students will be tested to see, in fact, if their math skills have improved.

Longmont Times Call
Late April, 1981

Appendix E (cont.)

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Longmont Times Call
Late April, 1981

Photo by John Epperson

Above from left to right, Columbine Elementary school students Susan Norris, Carl Leonard and Nacho Gonzales work on a computer program

...student tutors from Skyline High are using computers to help the younger students with math problems

Appendix E (cont.)

Sept. 198

The Skyline Sun

Skyline High School, Longmont, Colorado Volume 4, Number 1

Funding Needed For Computers

by Peter Schuerman

This is the last year that Computer Math, in which the students get "hands on" experience with actual computers, will be offered at Skyline. With additional funding, the program can be continued.

The program, funded by the National Science Foundation, was conceptualized by CU professor Dr. Marc Swadaner as an experiment. The Program's goal is to discover whether or not computers are successful math tutoring devices for 6th graders. They also hope to see if these students are motivated to take more interest in mathmatics careers. Skyline's 34 computer math students are taught how to use the computers during first semester, and then tutor 6th graders second semester. Paul Canny, Computer Math instructor, said, "Last year the program had a big effect (good) on the math scores of the 6th graders we tutored."

At present, Skyline's Computer Math class has nine *Apple* computer consoles (these house the computer chips which are the heart of the system, and also include a keyboard used for transmitting information), nine monitors (television screens connected to the consoles. These display words, pictures, etc.), and nine disk drives (these record information on small record-like "diskettes" for later use, so that information can be played back into the computer rather that being typed in). We also have three printers (used for printing information from the computer on paper), and three graphics tablets (used for drawing pictures on the monitor). A console, monitor, and disk drive alone can cost around $3,000.

The program was designed so that at the end of this school year two-thirds of our computer equipment would go to the St. Vrain valley School District to be distributed to its schools, while the remaining third would go to CU.

Next year, if computers are again available for our school, more applications are being planned. One idea is a computer math class without the tutoring. Also, since re-creations of things such as the Three Mile Island incident and labor strike negotiations can be "played" on the computer, computer usage can extend to science and social studies. "We hope", said Paul Canny, "to have a computer available in the library for students to use."

Two Skyline students work on an APPLE computer terminal. These computers could become a permanant part of Skyline. Photo by Dave Manuel

Certificate of Award

This Certifies That

_____

a student of the _____ School

is awarded this Certificate for

_____

_____

Date _____ _____

REV 11/27/81 APPENDIX G

PERSONAL COMPUTERS AND CROSS AGE INSTRUCTION **

School of Education
University of Colorado #249
Boulder, Colorado 80309

and

St. Vrain Public Schools
395 S. Pratt Pkwy.
Longmont, Colorado 80501

Dr. Marc Swadener
Principal Investigator
University of Colorado-Boulder

Mr. Paul Canny
Project Director
St. Vrain Public Schools

The project staff are developing a combinational strategy using personal computers and cross-aged instruction in order to:

1. Increase the level of basic mathematical skill of mathematically low-achieving sixth grade students.

2. Increase the number of students enrolling in high school mathematics and science courses.

3. Evaluate microcomputers as a unique instructional tool.

4. Develop effective applications of microcomputers in education.

The plan for the attainment of these goals includes the selection of sixty able high school students and sixty mathematically low achieving sixth graders, half of each group will serve as a control group. During the pre-tutoring period the high school students will study specific areas of mathematics weakness of the thirty sixth grade students, will become familiar with the operation of microcomputers, existing software and generate their own software for the purpose of tutoring the sixth graders. During the tutoring period the high school students will tutor on a one-to-one basis the sixth grade students using the microcomputer as a tool and continue their study of mathematics and microcomputers.

The anticipated results of the project include an increase in mathematical skills in both the high school and sixth grade students and increased enrollment in mathematics and science courses.

The project is in effect for the 1980-81 and 1981-82 school years. The fall semester 1980 was for planning, spring semester 1980-81 was the pilot phase and the 1981-82 school year is the experimental phase. A brief report follows.

** This material is based upon work supported by the National Science Foundation under grant #SED-7918974. Any opinions, findings, and conclusions or recommendations expressed in these materials are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Appendix G (cont.)

PERSONAL COMPUTERS AND CROSS AGE INSTRUCTION **

SUMMARY REPORT - FIRST YEAR

PILOT PHASE - SPRING SEMESTER 1980-81

Time line:

February	March	April	May
Pre-tutorial Period		Tutorial Period	

- Nine weeks
- Two sections (afternoon)
- High school only
- Five classes per section per week

- Eight weeks
- Two sections (afternoon)
- High School and two Elementary schools
- High school students are transported
- Tutoring takes place in the elementary schools
- For each two week time period:
  - Five classes/section in elementary schools and high school
  - Classes in elementary and high school on alternate days

I. Equipment used

The equipment used in the project are nine APPLE II+ 48K SINGLE DISK DRIVE (DOS 3.3) microcomputers with language systems , nine color monitors, three Epson MX-80 printers with GRAFTRAX-80 graphics capability, and three APPLE graphics Tablets.

II. Pre-Tutorial period

A. Testing and Administration (10% - 4.5 hours)

B. Tutoring preparation (50% - 22.5 hours)

1. Techniques of tutoring
2. Characteristics of sixth graders
3. Psychology of learning
4. Stages of development
5. Lesson planning
6. Discipline
7. Active vs. passive learning
8. Problem solving
9. Sixth grade mathematics curriculum scope and sequence
10. Reinforcement
11. Memory and mastery
12. Estimation
13. Questioning

Appendix B (cont.)

C. Microcomputers (40% - 18 hours)

1. Orientation to hardware
2. Hardware capabilities
3. Operating procedures
4. Vocabulary
5. Elementary programming commands
6. Software review (drill and practice, tutorials, simulations and games)
7. Variables and variable names
8. Social impact of computers

III. Tutorial period

A. Amount of tutoring time:

The amount of time available for tutoring was dependent on the length of the classes at the high school. Each high school period was fifty minutes in length and the high school students were transported to the elementary schools by school bus. Round trip transportation time was between fifteen and twenty minutes, permitting approximately thirty minutes for each tutoring session. One section of the high school students was transported to one elementary school and the other to the second elementary school. The ratio of the number of high school students in the two sections was approximately equal to the ratio of the enrollments in the two elementary schools (2:1). High school students were transported to the elementary schools every other day (Tuesday and Thursday one week, Monday-Wednesday-Friday the next week). On other days the high school students remained at the high school, planned for the tutoring sessions and continued their familiarization with microcomputers. Thus the total amount of time actually tutoring elementary school students over the eight weeks of the tutoring period in the pilot was about ten hours.

B. Computer time in the tutoring situation:

The distribution of equipment over the three schools was such that the high school retained four machines for continued training of the high school students, three machines were placed in one elementary school and two were placed in the other. No machines were transported between schools for tutoring. Thus, over the eight weeks of the tutoring period, the total computer time available to the elementary students was sixty-seven hours. This time had to be distributed over the twenty-nine elementary students, therefore each elementary student was able to use a computer (under the direction of a high school student) for at most 2.3 hours over the eight weeks or an average of slightly more than one-half hour for each two weeks.

C. Non-computer tutoring time:

The secondary students under the direction of the elementary student's regular teacher and Mr. Canny, the Project Director, assessed the elementary students mathematical difficulties and provided tutoring on a one-to-one basis. Over the eight week tutoring period the secondary students provided each sixth grader about 8.7 hours of "off line" tutoring concerning the sixth grader's mathematical difficulties.

D. Timing of the tutoring sessions:

As much as possible tutoring took place during the regular mathematics instruction in the elementary school. Because of this the elementary participants in the project received one-to-one tutoring in place of up to one half of their regular mathematics instruction for the eight weeks in the tutoring period.

IV. Summary of results of the pilot phase (these are NOT final results):

The reader must understand that while data were collected during the pilot phase the major purposes of the pilot phase were not to effect significant changes with respect to the overall goals of the project. The primary purpose of the pilot phase of the project was to "shake down" procedures and materials used in the project. This was accomplished. In the pilot phase much data were collected and are still being collected, some of which is as yet unavailable for the reporting of results. However some preliminary results of the pilot phase of the project can be reported.

Growth in achievement for the elementary participants was greater that that for a control group of randomly selected sixth graders, however the difference was not statistically significant.

The only measure of change for the secondary participants available at the time of the writing of this report concerns a measure of attitude toward mathematics. This measure was given in a pre-post format over an interval of eleven weeks. The results indicate a negative change in attitude toward mathematics for the secondary participants but the change was not statistically significant. The project staff feel there were many identifiable incidents which mitigated against any significant positive change. These include a two and one-half month delay in receiving equipment, the number of "missing cases" in the analysis, the informal nature of the attitude measure, the shortness of the attitude measure and the negative predisposition of the participants to testing as exhibited by numerous comments concerning having to "take the test". With this background the project staff do not take the results of the pre and post attitude measure with much seriousness. We have though gained in our pool of experience and knowledge of testing the groups in which we are involved. This will be of great assistance in the experimental phase outlined below.

All other data in the pilot phase is still incomplete at the time of writing of this report. These data include enrollment patterns and attendance of the participants.

EXPERIMENTAL PHASE 1981-82

The experimental phase of the project, the 1981-82 school year, will be arranged similar to the pilot phase except that a full year will be used instead of just one semester. The treatment period will therefore be twice as long as during the pilot phase for both the elementary and secondary participants and we are going to attempt to markedly increase the available "on line" time for the tutoring sessions beyond the mere doubling of the time interval by transporting equipment between schools. New groups of secondary students have been chosen, their instruction has begun and soon the project staff will begin the process of selecting the elementary particpants. Students are selected on the basis of test scores, parental approval, teacher recommendation and other criteria.